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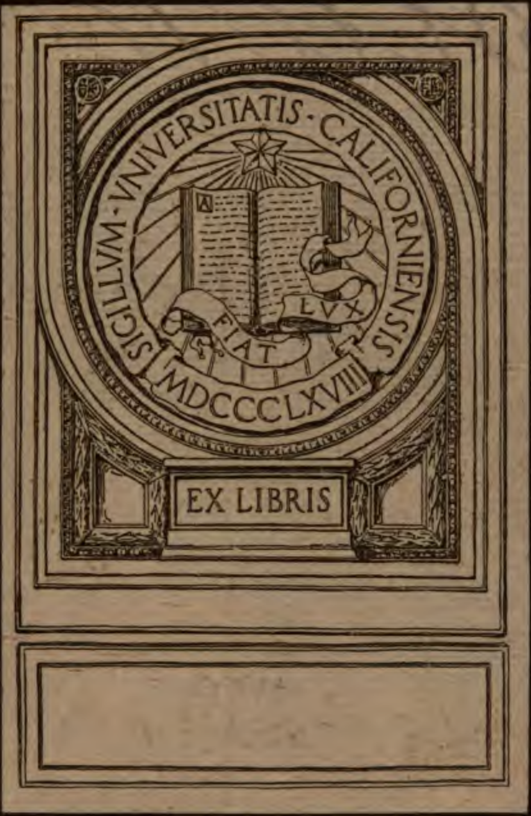

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THE ELEMENTS OF

SPECIFICATION WRITING

A TEXT-BOOK FOR STUDENTS IN CIVIL ENGINEERING

BY

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FIRST EDITION
FIRST THOUSAND

UNIV. OF
CALIFORNIA

NEW YORK
JOHN WILEY & SONS, Inc.
London: CHAPMAN & HALL, Limited
1913

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RICHARD SHELTON KIRBY

Stanhope Press
F. H. GILSON COMPANY
BOSTON, U.S.A.

PREFACE

This book is a text-book on the art of specification writing, not a collection of specifications. While intended primarily for the classroom, it should prove of value to the young engineer in practice. The book is the outgrowth of a series of lectures delivered by the author annually for the past six years before the senior class in Civil and Sanitary Engineering in the Sheffield Scientific School of Yale University.

The following features are worthy of note here:

(1) The fundamentals of a contract — particularly of a construction contract with its attendant plans and specifications — are concisely brought out.

(2) A chapter is devoted to the Advertisement and one to the Proposal.

(3) The General Clauses (Chapters VI to XI inclusive) are given thorough exposition, from an Engineer's viewpoint. Many interesting cases illustrating their application to actual construction work are cited and discussed. Numerous and varied model clauses are quoted.

(4) Chapter XII contains practical suggestions touching the Specific (or technical) Clauses. Outlines of such clauses for nine simple construction projects (Chapter XIII) will assist the student as he essays for himself the composition of specifications. The outlines cover work with which the average student is more or less familiar — a manifest advantage to the beginner.

(5) The classified list of references (largely to recent articles in the more readily accessible technical journals) in the Appendix will furnish student and instructor a fund of commentary and illustration.

To secure the maximum of efficiency in the use of the book as a text it is suggested that the instructor gather — as he easily

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may — a large and carefully selected assortment of specifications for collateral use by the class. The student should prepare abstracts of these in connection with his study of Chapters VI to XI; he will also find in them suggestions as to the wording of the specific clauses outlined in Chapter XIII.

Professors S. E. Barney and J. C. Tracy of the Sheffield Scientific School have read the manuscript and furnished helpful criticism. The author wishes here to record his appreciation of their kindness.

RICHARD S. KIRBY.

GETTYSBURG, PA.,
May 5, 1913.

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THE ELEMENTS OF SPECIFICATION WRITING

CHAPTER I

INTRODUCTION

1. **Construction Work Classified.** — For the sake of brevity we shall make frequent use of the term "Owner" as referring to the person, firm, private corporation or public corporation for whom construction work is done. While important work not infrequently necessitates, in these days, the coöperation of engineers in many capacities, we shall use the word "Engineer" in speaking of the Engineer employed by the Owner.

(*a*) The Engineer may, as agent for the Owner, direct all the operations, even to purchasing the materials and paying the workmen. The Panama Canal and the Los Angeles Aqueduct are being constructed under such an arrangement; the Corps of Engineers of the United States Army, various railroad corporations and some municipalities carry on a portion of their construction work under this or a slightly different plan. The term "*force account*" is generally applied to this arrangement, which is a very flexible one, but one to which slight reference will hereafter be made in this book.

(*b*) A modification of the above plan consists in the employment by the "Owner" of a third person, called a "Contractor," who agrees to furnish whatever material and labor is from time to time needed and to direct the work (under the Engineer's supervision), in return for which he agrees to accept as payment an amount slightly greater than the cost to him. This is commonly called having a piece of construction done by "*day's* *work,*" although the term "force account" has been applied here as well. According to the terms of the agreement, the price paid the "Contractor" may be related to the cost to him in one of two ways, namely:

(*i*) *Cost-plus-a-percentage.* With this arrangement the price paid by the Owner is computed by summing up the cost, to the Contractor, of materials and labor (with sometimes a further allowance for incidental expenses such as depreciation, office rent, etc.), and adding to this sum an agreed percentage of profit.

(*ii*) *Cost-plus-a-fixed-sum.* This varies from (*i*) simply in that the amount added is a prearranged sum, not a prearranged fraction of the cost.

It may be said of the day's work plan (including both (*i*) and (*ii*)), that if no necessity exists for fixing in advance a maximum allowance of either time or money, and if unlimited confidence can be placed in the ability, energy and reliability of the Contractor, the method is nearly ideal. It is especially useful in emergency work, or for work the quantity or nature of which cannot well be foreseen, or for work of a hazardous or experimental character. The advantage of (*ii*) over (*i*) is that as profit no longer varies with cost to the Contractor, there is no temptation on his part to increase the cost. Comparatively little American construction work has been done under this plan, although a considerable number of buildings have, within recent years, been erected on the cost-plus-a-fixed-sum basis.

The student is referred to *Engineering News,* 1912, vol. 68, p. 392, for the outline of a proposed sliding scale payment plan in which an incentive to economize is furnished the Contractor. This and like schemes, while ingenious, have not, to the author's knowledge, been given extensive trial in practice.

(*c*) Much the larger proportion of construction can be classed as "contract work." This is a convenient term for that which is carried on under an agreement by which the Owner is to pay the Contractor a definite sum for his work (or for each separate part), regardless of the Contractor's profits. In contract work, although the Owner's interests are still looked after by the Engineer, much of the responsibility for the execution of the work is shifted to the Contractor's shoulders.

2. Contract Work.

(*a*) Objections sometimes urged against "contract work" are:

(*i*) That profits are exorbitant. This is doubtless true at times, and where no *bona fide* competition exists. But, on the other hand, the student should recognize the fact that a reasonable percentage of a contract price is legitimate profit. Further than this, a Contractor is perfectly justified, as his work progresses, in endeavoring to increase his net profits by wise planning, careful supervision and economy — not by slighting his work or by endeavoring to substitute inferior workmanship or materials. The best work is not necessarily that which has proved most costly to the Contractor.

(*ii*) That undue haste may result in poor construction. Here again it is true that most kinds of work can be either well and rapidly done or poorly and rapidly done.

(*iii*) That altering the design is difficult and expensive. This is a valid objection only when the design cannot be thoroughly worked out in advance.

(*b*) It may be added, moreover:

(*i*) That contract work is generally cheaper, since it lends itself more readily to competition.

(*ii*) That a definite price has oftentimes many distinct advantages for all concerned.

(*iii*) That in case the Owner is a public corporation, any other plan than that of contract work is commonly forbidden by law.

3. Documents. — In connection with a single piece of construction work done under contract it is frequently necessary to prepare six documents, *viz:*

(*a*) *Contract*,

(*b*) *Bond* (or bonds),

(*c*) *Advertisement* (or Notice to Contractors),
(*d*) *Information for Bidders,*
(*e*) *Form of Proposal,*
(*f*) *Specifications.*

The responsibility for the preparation of the last three of these should, and usually does, rest entirely with the Engineer, and he is generally expected either to prepare portions of the others, or at least to be familiar with their contents. On work of any magnitude the contract proper should be framed entirely by the Owner's legal adviser, or be subject to his approval, while the bond is essentially a legal matter.

Where the magnitude and importance of the work warrant the extra expense involved, all of these documents, generally excepting the advertisement, are printed and bound together in pamphlet form. The best practice is tending away from the ancient and cumbersome legal cap form, bound at the top, toward a much more convenient form six or eight inches wide and nine or ten inches high, bound at the left edge like an ordinary book. This improved form, together with marginal headings, intelligent selection of type and an index, are recent innovations which make it possible for one to refer to any portion of the composite document with the minimum expenditure of time and effort.

CHAPTER II

CONTRACT AND BOND

In this Chapter are briefly discussed the essentials of a valid contract, the ways in which it is discharged, and the interrelation of contract, specifications and plans. A typical contract form is given. The significance of surety bonds is explained, and a specimen bond given for illustration.

4. **Definition.** — A contract is an agreement between competent persons to perform some legal act.

The subject of the law of contracts is outside the scope of this book, further than a brief discussion which will be entered into in the hope of making clear some otherwise obscure points in connection with the writing of specifications.

5. **Reference Books.** — While many construction contracts are drawn by engineers, the author wishes to be understood as advising the young practitioner that he proceed slowly in this direction, remembering that a little knowledge may prove to be dangerous. Next to a course in law is recommended to the student or young engineer a thorough study of some of the following standard works:

Anson, "Law of Contracts" (a book primarily for law students).

Wait, "Engineering and Architectural Jurisprudence" (for the lawyer, engineer and architect).

Tucker, "Contracts in Engineering" (for the engineering student or practicing engineer — covers much beside construction work).

Beside these there are a number of standard treatises on contract law, such as Parson's, Lawson's, etc., some of them far less condensed than those mentioned above and correspondingly less satisfactory to any but the practicing lawyer.

6. **Contract Essentials.** — In order that a contract may be binding it is necessary:

(*a*) That the *parties* * be *competent.* The courts will not enforce contracts made with persons under legal age ("infants"), convicts, confirmed drunkards, insane persons and the like, or with corporations in matters in which they exceed their charter rights, or with agents when they exceed the authority delegated them by their principals, etc.

(*b*) That the *subject matter* be *legal.* Contracts to perform acts contrary to either common law or statute law, or opposed to public policy are not binding. Municipalities must comply with statutes defining their debt limit, or dealing with the manner in which they shall advertise or award contracts, sell bonds, etc. A compulsory arbitration clause (Art. 33), and a penalty clause (Art. 53), have been classed as opposed to public policy.

(*c*) That the *parties* have *mutually agreed.* Every contract springs from the acceptance of an offer. Each party must have, however, understood and assented to the offer in precisely the same sense. When it can be shown that either entered into the agreement through certain mistakes, or misrepresentation, or fraud, or duress, or undue influence, it will generally be held that as the agreement was only apparent the contract was not binding. A contract (unless for work extending over more than a year) need not be written, although it is often difficult to establish the existence or the exact terms of an oral contract.

(*d*) Further, unless the contract is a "sealed" one (one in which a "seal" has been affixed to the signatures), there must be a "*valuable consideration.*" Engineering construction contracts include valuable considerations, and in most cases need not be "sealed" (unless one party is a corporation whose officers are required to use a seal). Valuable consideration is not necessarily adequate compensation, but may consist (according to an old English decision) "either in some right, interest, profit or benefit accruing to one party, or some forbearance, detriment, loss or responsibility given, suffered or undertaken by the other."

---

* A legal term meaning the persons who have entered into contract — the principals.

Distinguish between common and statute law.
Define equity; the statute of frauds.
Discuss the origin of a " seal "; consideration.

7. **Discharge of Contracts.** — A contract may be terminated or "discharged" in a number of ways:

(*a*) By *performance* of its every detail. Strictly speaking, this rarely occurs in connection with a contract for construction work.

(*b*) By *mutual agreement*, that is, the parties may (before the terms of the contract have been fully carried out) agree, each for a consideration, that the contract shall no longer hold them. This would be called a "waiver" of the contract. Sometimes this takes the form of a new contract substituted for the old one, as in the case of substantial alteration, by common agreement, of the terms of the original contract. (See Art. 29.)

(*c*) By *operation* of the *rules of law.* Alterations in the document made by one party without the knowledge and consent of the other would discharge the contract, as would also the "going into bankruptcy" of either.

(*d*) It may *become impossible.* The word impossible has been rather strictly construed by the courts. A contract to repair leaks in a dam or to paint a bridge would be rendered impossible of performance in case the entire structure were wrecked and carried down stream by a freshet. (See Art. 43.)

(*e*) It may *be broken*, by either party's failing to carry out any single one or all of the stipulations which form his part of the agreement. The injured party has then the right of action, that is, he may sue for damages, or in some few instances (not affecting construction work) to compel performance. (See Art. 53.)

8. **Design.**

(*a*) Put in another way, a contract may be somewhat loosely defined as an agreement entered into between two competent persons, by the terms of which agreement one of them agrees to perform for the other a certain (legal) act, for which the other agrees to pay him. Some acts can be defined in very few and simple words. The act of a Contractor in constructing even an unimportant structure is complex. In order that the act may be properly described in the contract it is necessary:

(*i*) That some person shall have a mental conception of the finished project (even though the conception be somewhat vague as to some of the minor details).

(*ii*) That from his mental conception there shall be prepared a more or less detailed design.

(*b*) A complete design determines:

(*i*) The proportions and relative positions of each part.

(*ii*) The various materials to be used.

(*iii*) Certain qualifications as to workmanship.

9. Plan and Specifications; Specific and General Clauses.

(*a*) The proportions and relative positions of each part can best be shown graphically by a drawing, called the plan.* If, however, one should attempt to add to the plan all the necessary data as to materials and workmanship it would in most cases be found that the space was not sufficient and that the plan was obscured. This sort of information can in fact be more clearly conveyed by means of a separate document, and forms a large part of what is called the "*specifications*," namely the *specific clauses* therein.

The word specific is rather misleading, implying as it does that other clauses are not specific or precise. "Descriptive" or "technical" clauses would perhaps be better terms. The specific or technical clauses in the specifications describe, then, materials and workmanship, or in other words they define the work from the standpoint of the Engineer.

In the case of a steel bar, the plan would give its dimensions and its position with respect to the rest of the structure, while the specifications would prescribe the material, its manufacture, testing, etc., with perhaps some added requirements as to its fabrication and exterior finish.

The plan for a simple monolithic concrete structure would show the detailed dimensions of each portion, while the specifications would properly prescribe the proportions and quality of the several materials composing the aggregate, with instructions regarding mixing, laying and finishing the concrete.

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* Whether all the details of the plan have been determined on at the time of the signing of the contract (as they ought to be if at all possible), or whether some must later be worked out, either by Engineer or Contractor, it is still possible to refer to those drawings which illustrate the essential features of the design as "the plan."

(*b*) Further than this, however, there are certain contingencies to be provided for, some of them only remotely related to actual construction, but all of them bearing on the business and legal dealings of the parties concerned with the construction. These matters are treated in a distinct section of the specifications, in a group of clauses commonly known as the "*general clauses*," sometimes as "clauses of general application."

The general clauses treat of various phases of the work, or of a variety of situations that might arise during its construction, from the standpoint of the lawyer or of the business man. They are called "general" because their wording is such that the same clause could be made to apply to any of a number of pieces of work differing widely in character. Such a clause might, for example, fit equally well into specifications for building a bridge, a sewer or a pumping plant. Judgment should, however, be exercised in the selection or transferring of general clauses, and the "scissors and paste" method should be practiced sparingly and with discretion.

A case in point was brought out by the recent destruction by the waves, during an unusually severe storm, of a sea wall in course of construction at the extremity of an isolated rocky promontory. An examination of the specifications made subsequent to the catastrophe, to determine whether or not the Contractor could be required to rebuild the wall, disclosed the fact that the Engineer in copying some of his general clauses from specifications for an entirely different structure located elsewhere had used a clause referring to damage by fire, but had made no provision for damage from the waves.

(*c*) The line between general and specific clauses is not a perfectly sharp one, and a few clauses would seem to fit equally well into either group. (See Art. 47.) Other clauses, often classed as general, actually relate neither to business nor to legal matters, and might more properly be termed "clauses of convenience." (See Art. 32.)

(*d*) The general clauses discussed in Chapters VI to XI comprise those in most common use. Not all would of necessity be included in specifications for work which was simple and inexpensive, while work of considerable magnitude and complexity might sometimes require more. If the work is for a public corporation there may be statutes requiring that certain stipulations be included in contract or specifications. (See Art. 41.) It may often seem that the general clauses treat of certain apparently remote contingencies with unnecessary explicitness, but it must be remembered:

(*i*) That the specifications are prepared before it is known who the Contractor is to be. Were it otherwise many of the general clauses could, in some cases, be much abbreviated or wholly omitted; and

(*ii*) That the object of inserting many of these clauses is to keep both parties to the contract out of law, if possible. In this respect the nature of an Engineer's service to his client is not unlike that of a physician who is regularly paid so long as he keeps his patient in good health.

(*e*) Good practice differs as to how many, if any, of the "general" clauses should have a place in the contract proper and how many in the specifications. Many lawyers, for example, insist that clauses such as those relating to extra work (Art. 56), damage to persons or property (Art. 42), and perhaps a few others, are more binding if made express covenants of the contract. The author believes that if the specifications, "*in toto*," are made beyond question a part of the contract, using the arrangement suggested in Art. 10 the distinction is too fine to carry much weight. It may be noted that such clauses vary slightly in phraseology with their surroundings. A distinct stipulation or covenant in the contract might open with the words "And it is further understood between the parties hereto" or "The party of the second part hereby further agrees," while the same point could be covered in the specifications in language beginning "The Contractor shall."

Do not attempt to make a point more emphatic by covering it in both contract and specifications. This is an implied confession that the point has not been made sufficiently clear in one instance, and may lead to serious difficulties.

10. Combining Contract and Specifications.

(*a*) In view of the foregoing it is readily seen that the specifications are intended simply as a part of the contract. This fact should always be stated in the contract, making the specifications (and plan as well) a part of the document by "reference" (a legal term). There are several ways in which they may be related physically, and the student should note at least two from actual copies examined. The author believes that the most satisfactory method of combining contract and specifications is shown in the following example:

(*b*) *SPECIMEN CONTRACT FOR CONSTRUCTION WORK.*

This form is given not to be accepted blindly but simply as an illustration of a method of combining specifications and contract.

THIS AGREEMENT, made this tenth day of April, nineteen hundred twelve, between *John William Smith* of the town of Greencastle and state of Connecticut, *Party of the First Part,* and *Peter Brown* of the same town and state, *Party of the Second Part.*

WITNESSETH that the said Party of the Second Part hereby agrees for the consideration hereinafter mentioned and under penalty of a bond bearing even date herewith and hereto annexed to furnish all materials, tools and labor and to construct and complete on or before the first day of July nineteen hundred twelve a certain retaining wall near the residence of the said Party of the First Part.

AND the said Party of the Second Part agrees that the said work above mentioned shall conform in every respect to the annexed plan and specifications both of which are hereby made a part of this agreement.

(Here insert the entire specifications, and if possible the plan.*)

And the said Party of the First Part hereby agrees to pay to the said Party of the Second Part when the entire work herein described shall have been completed the sum of one thousand and fifty dollars ($1050.00).

In Witness Whereof the parties hereto have hereunto set their hands and seals the day and year first above mentioned.

............Party of the First Part.

............Party of the Second Part.

Seals.

Witnesses.

11. Surety Bonds.

(*a*) The most common form of surety bond is, in essence, so far as it relates to the business of contracting, an agreement on the part of a third person (or corporation), called the Surety, to pay the Owner a certain sum of money in case the Contractor fails to live up to (a part or all of) his agreement. It is drawn in the form of a contract, peculiarly arranged. Examination of the specimen surety bond given below will show that the first part of the agreement is to the effect that the Surety will pay the Owner a certain sum of money, apparently without any reservations attached. In what seems like a postscript there is added the condition under which the money is to be paid.†

(*b*) The amount of surety bond required in connection with construction contracts varies from perhaps 25 to 100 per cent of the contract figures. Private individuals of means may and do act as sureties, but the growing practice of requiring "surety company" bonds is to be commended. Contractors pay these companies a small fee for acting as sureties, and the companies assume little or no risk in the matter, since they in turn require valuable security of the contractors.

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* A simple process for reducing plans to the size of specification sheets is described in *Engineering Record*, 1911, vol. 64, p. 725, and *Engineering News*, 1912, vol. 67, pp. 351, 545. It should make possible the inclusion of plans under the same cover with specifications and contract at little additional expense.

† For a brief discussion of suretyship the student is referred to Tucker's "Contracts in Engineering," pp. 17 and 282.

(*c*) A bond furnishes no better security than the financial integrity of those who stand back of it. Even when this is of a high order various complications may arise rendering the bond of doubtful value. (See Arts. 29, 52.) In any event the Owner would generally be obliged to enter suit to recover anything on it. Despite these limitations, a bond is an almost universal accompaniment of construction work.

(*d*) *SPECIMEN SURETY BOND.*

The following is offered not in any sense as a model, but simply as an illustration of a form rather briefer than the average:

KNOW ALL MEN BY THESE PRESENTS, that we, *The John Doe Contracting Company* of Smithville, Conn., called the "Principal," and *The Reliable Surety Company of New York City*, hereinafter called the "Surety," are held and firmly bound unto the town of Smithville in the state of Connecticut in the sum of five thousand dollars ($5000.00) lawful money of the United States of America, to be paid to said town of Smithville, for which payment well and truly to be made we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

Sealed with our seals. Dated this twenty fourth day of September in the year of our Lord one thousand nine hundred and twelve.

WHEREAS the above bounden Principal has entered into a contract with the said town of Smithville bearing even date herewith and hereto annexed, for constructing a pavement on Bank Street in said town in accordance with plans and specifications therefor on file with the Clerk of said town, *now therefore*

THE CONDITION OF THIS OBLIGATION IS SUCH that if the said Principal shall well and truly keep and perform all the terms and conditions of the said Contract, on his part to be kept, then this obligation shall be of no effect; otherwise it shall remain in full force and virtue in law.

(*Signed, Sealed and Witnessed.*)

(*e*) Some bonds include in the last clause a reference to alterations, to negligence or to default on the part of the Principal, to patent infringements, to payment for labor and materials and the like. In connection with certain work, separate bonds (in addition to the "faithful performance" bond) are required, each covering one of these several risks. For example, a "Labor Bond" might differ from the illustration given simply in the last clause, which might read:

"*The Condition of this Obligation is such* that if the said Principal shall well and truly pay in full at least once a month all laborers who may be employed on the work specified in such contract, then this obligation shall be void, otherwise it shall remain in full force and effect."

CHAPTER III

ADVERTISEMENT (OR NOTICE TO CONTRACTORS) AND INFORMATION FOR BIDDERS

This Chapter treats of advertising, more particularly as applied to public work; the essential features of the Advertisement and its sequel, the Information for Bidders, are discussed.

12. Necessity for Advertising. — Unless circumstances are exceptional, contracts for engineering construction work are let only after a more or less extensive competition among contractors, which is secured by inviting a number of them to submit each an offer to do the work.

(*a*) If the work is unimportant, not likely to attract a large number of prospective bidders and is to be done for private individuals or corporations, contractors may be communicated with somewhat informally.* For example, the Engineer or the Owner may speak or write to those whom they think will be interested. Where the work is of some magnitude, however, this method may be neither strictly fair to all contractors nor most advantageous to the Owner and the plan outlined in (*b*) may be more or less completely followed.

(*b*) In connection with work where the Owner is a public corporation (as a borough, village, town, city, county, state or nation) it is by law or ordinance generally provided that a wide and formal invitation be given through the public prints to all interested.† This formal invitation is called an Advertisement, or Notice to Contractors. Some ordinances provide that copies of the Advertisement be also posted in certain public places.

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* Public service and other corporations, as well as private persons do, of course, advertise when it appears to them advisable.

† It is common to except work of a trivial nature (involving the expenditure of only a few hundred dollars) and sometimes emergency work — although the word emergency may be subject to varying interpretations.

Further than this it is frequently desirable, and some local ordinances so provide, that the Advertisement be published in one or more of the technical papers which have a circulation among contractors likely to be interested. The Advertisement should first appear a sufficiently long time in advance to give prospective bidders a reasonable period in which to make their necessary business arrangements. Less than two or three weeks is seldom sufficient and a much longer period is allowed on extensive and complicated contracts. The Advertisement should appear at stated intervals during the period.*

A typical city ordinance relating to the advertisement of public work follows:

"All contracts to be made or let for work to be done or for supplies to be furnished to said City, except . . . , shall be made by the departments, boards, or by the officers having the subject matter in charge. Whenever any work is necessary to be done to execute or perfect a particular undertaking, or any supply is needful for any particular purpose, and the several parts of the said work or supplies shall together involve the expenditure of more than two hundred and fifty dollars, a written contract for such work shall be made . . . , which contract shall be founded on sealed bids or proposals, . . . , made in compliance with public notice, duly advertised by publication, at least ten days before the time fixed for opening said bids or proposals, . . . provided, however, that all street cleaning, general repairs and general maintenance of the highways in said city may be performed at the expense of said city under the supervision of the proper department thereof without calling for any bids or making any contract."

13. Essentials of an Advertisement. — The essential points to be covered by an advertisement are:

(*a*) *Character* of *work* indicated by *title* of Advertisement.

An advertisement headed simply "Notice to Contractors" or "Bids Required" will not be so likely to catch the eye of a contractor (for example) who makes a specialty of waterworks construction as will one entitled, "Water Supply System," or

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* Major Gillette (*Engineering News*, 1907, vol. 57, p. 587) cites an instance in which public work aggregating $4,000,000 was advertised 18 days in obscure papers. He says that $9 out of every $10 which the city paid out as a result of this practice was wasted. Fortunately for the taxpayers the contract was broken before more than a fraction of the work had been performed.

"Pipe Laying" or "Filter Beds." A suggestive title attracts the attention of men whom the advertisement is designed to reach and does not waste the time and attention of others.

(*b*) Name of ***person*** who will ***receive bids***, with ***place***, ***date*** and ***hour***.

Remembering that a prospective bidder may be a stranger in the locality and that he may read the advertisement hastily, make this point so clear that it cannot be misconstrued. It is customary to state that bids will be received ***not later*** than a certain hour of a certain day.

(*c*) Name of ***Owner***. (Person or corporation for whom the work is to be done.)

This is simply to inform the prospective bidder as to whom he will have to deal with in his business relations.

(*d*) Brief ***description*** of ***work*** with ***approximate quantities***.

A contractor of large resources would not be looking for small contracts, nor would a contractor with limited capital, meager plant and little experience be apt to be looking for a very extensive contract.

(*e*) A specific statement as to ***character*** of ***bids*** desired.

(*i*) Will bids for sections of the work be considered? For example, a sewerage system might advantageously be built by several contractors, each working in a separate locality. Or a steel bridge might be erected by two contractors, one building the substructure and the other the superstructure. Such a division into several contracts may result in a lower total cost, allowing as it does greater competition among bidders. The advantage of lower cost resulting from subdivision of the contract is sometimes more than offset by increased engineering and other expenses incident to delay and lack of coördination or coöperation.

(*ii*) Will bids for labor only, or for materials only, be considered? There is an increasing tendency on the part of municipalities to adopt one or the other of these plans. Sometimes the Owner may be in position to furnish material or labor more cheaply than any one else. For example, a city or other corporation may own a stone quarry, or it may have a force of laborers under salary. In any event it should be clearly stated in the Advertisement just what option, if any, will be allowed the bidder in these directions.

(*f*) *Security required with proposal.*

This security is required as "earnest money," to make reasonably certain that each bidder is acting in good faith, and is consequently willing to sign the contract if it is awarded to him. The advertisement should state:

(*i*) The purpose for which the security is required, or the conditions under which it is to be offered. This is so generally understood that many advertisements contain no reference to it. The time and place of the return of this security might be given.

(*ii*) The character or form of the security. It should be in the equivalent of cash; often a certified check is required, sometimes a bond; if a check it is important that the payee be here specified.

(*iii*) The amount of the security. In case the successful bidder refuses to enter into contract the delay is likely to cost the Owner many incidental losses, some of which, as interest charges, salaries, etc., are apt to be overlooked. The security should therefore be large enough to somewhat more than compensate him for the bare expense of readvertising. The actual amount fixed is seldom less than one per cent or more than five per cent of the cost of the work. Some advertisements require each bidder to furnish the same sum, while others require a uniform percentage of the several bids. The latter plan has furnished unscrupulous officials and others a means of learning the amounts of some of the bids before they were formally opened.

(*g*) *Amount* of *security* required with *contract.*

The student should not confuse this with the security mentioned in (*f*). It is particularly desirable that the amount be here stated if it is larger than would be expected. Why? (See Art. 11.)

(*h*) *Conditions* of *payment.*

It would be necessary to state these only in case they varied much from common practice. (See Arts. 57, 58.) The variation might be so great as to deter some contractors from undertaking the work.

(*i*) *Information* as to *consultation* of *plans*, etc.

State explicitly where and when plans and other information can be examined, whether they will be mailed gratuitously on request or whether or not copies may be borrowed on payment of a deposit. The latter arrangement is becoming increasingly common where the drawings are elaborate and the specifications voluminous, and their duplication would involve considerable expense.

(*j*) Reservation of the *right to reject* all bids.*

Rejection of all bids may be advisable where:

(*i*) There exists a well-grounded suspicion of collusion between bidders, or of some other form of fraud.

(*ii*) The lowest bidder is known to be irresponsible or notably inefficient.

(*iii*) Radical changes in the design are found necessary during the interval preceding the opening of the bids.

(*k*) The Advertisement should be *dated* and *signed* by the clerk, secretary or other proper person, and the name of the Engineer should appear thereon.

The student should prepare an Advertisement for work of a simple nature (See Chap. XIII), using the above outline. Numerous examples will be found in current issues of technical periodicals.

14. **Information for Bidders.** — After a contractor has become sufficiently interested in the work to seriously contemplate bidding there are a number of preliminary questions which it is natural that he should ask. For the convenience of Owner and Engineer and in order to treat all the contractors uniformly, there is often prepared a pamphlet, termed "Information for Bidders," in which answers to these questions are embodied.

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* In some localities no rejection is allowed. (See Art. 19.)

In it is perhaps reiterated most or all of the Advertisement (or Notice to Contractors), portions being given at greater length; it may include, in addition, information on any or all of the following points, among others:

(*a*) *Reference* to *action authorizing* work, or to *statutes governing.*

In case the Owner is represented by a Town Council, for example, or is a private corporation, reference should here be made to any resolutions empowering the proper officers to proceed with the awarding of the contract. This enables the bidder for his own protection to examine into the matter and perchance avoid being drawn into a contract later to be declared void. The bidder's attention should also at this point be called to any statutes vitally and directly affecting the work or the cost thereof. The entire clause is sometimes made part of the specifications proper.

(*b*) *Restriction* of *bidders.*

Some municipalities will not accept proposals from contractors with whom they have had unpleasant dealings in the past — who have defaulted on contracts, for instance — or with whom they may be at the time in litigation.

Would an alien be debarred from bidding?

(*c*) Bidders to *state experience.*

This is a common requirement in certain classes of United States Government contracts demanding more than ordinary technical skill and training on the part of the Contractor — lighthouse construction for example.

(*d*) *Samples* to accompany.

Samples are necessary where it is thought advisable to allow some latitude in materials, or where a material is somewhat untried or difficult to describe. This provision finds wide application in connection with paving work. The samples in such cases are used as standards by which to judge the material later furnished. It has sometimes been provided that each bidder submit samples of the best and of the poorest grade of material he proposes to furnish. Where preliminary comparative tests are to be conducted, samples need to be submitted to the Engineer some time previous to the date set for opening bids.

(*e*) *Instructions* for *preparing bids.*

These cannot be too clear and explicit; failure in this respect may result in serious hardship to Owner or bidder. Directions should be given for endorsing bids, the required enclosures should be noted, together with instructions for sending them by mail. It may even be best in some instances to outline for the bidder's benefit his whole course of procedure in filling out the form and presenting the proposal.

(*f*) Detailed *estimate* of *quantities.*

The Advertisement sometimes contains this, but in general it should not. The Engineer may here enter into considerable detail, if it will further enlighten prospective bidders. It is best to state that the estimate is approximate only (if such be the case). If unit prices are submitted, this estimate is used as a basis for comparing bids.

Care in the preparation of this estimate is quite essential. A large error might involve serious consequences, even in the case of unit prices.

A certain Water Commission advertised for bids for building a dam, enumerating in the Advertisement and the Information for Bidders the approximate amounts of the several items included in the work. This statement followed: "The above estimated quantities are approximate and the Board of Water Commissioners reserves the right to increase or diminish the same as may be necessary in the judgment of the Engineer." It was further stated that each bidder must visit the work and inform himself as to the conditions. The work proved to be different than had been anticipated and some of the quantities many times greater than those given in the estimate, and the Contractor refused to finish. The City sued him but lost the suit.

The student may prepare an "Information for Bidders" for a sewer system in a small town, making all assumptions required.

CHAPTER IV

PROPOSAL

"Every contract springs from the acceptance of an offer." This Chapter is devoted to a consideration of the form of an offer or proposal for doing construction work. The relative advantages of "lump sum" and "unit price" proposals are considered, also the troublesome question of "unbalanced bids."

15. **Necessity for Form.** — A proposal is in essence simply an offer on the part of the bidder to do the work for a certain remuneration. It is quite customary for the Engineer to prepare a "Form of Proposal" and to require that each bidder make use of it. Such a form is necessary for three reasons:

(*a*) As a rule there are a number of conditions and qualifications necessary to append to the simple offer.

(*b*) A form insures definiteness (or precision). Since the bidder has simply to fill in certain blanks in sentences already framed for him it is reasonably certain that he will convey just the meaning he intends.

(*c*) A form implies uniformity. All proposals may then be considered on precisely the same basis. It would be manifestly impossible, for instance, to compare two bids for a piece of work, one of which was unconditional, while the other contained propositions to use different material than was specified, or proposed a longer time in which to finish, etc.* Such a comparison must not infrequently be made by a body of men who are not experts in either engineering or finance, and it is desirable that the proposals be submitted in such way that the comparison shall not be a difficult one.

The practice of binding the proposal sheet with the specifications and other papers is to be preferred to that of issuing it as a separate document.

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* Bids not made out on the form or those in which conditions have been introduced or struck out are called "informal" bids. Unless a very good reason exists for their consideration these are generally ignored. An alternative bid, unless duly provided for, would be informal, but might lead to a readvertisement.

16. Essentials of Proposal. — The following are the statements which it is desirable to include in a proposal.

(*a*) *Offer to do the work at stipulated price or prices and on terms proposed.*

As previously stated, this is the essence of the proposal. Space should be left so that each price may be expressed both in words and in figures. Many awkward situations have arisen in this connection owing to real or avowed blunders on the part of a bidder, such as writing dollars for cents or vice versa, misplacing the decimal point, etc. The Engineer should so arrange the wording and the blank spaces as to reduce the probability of such mistakes to a minimum.

(*b*) *Declaration that no fraud or collusion exists.*

While a statement that he was acting honestly, made over his own signature by a rogue, would have no moral or legal weight, it is common practice to require of each bidder that he shall state in his bid that his offer is made in good faith and without collusion or fraud. This is designed to discourage:

(*i*) The pooling of bids. *A*, *B*, *C* and *D* found that they were to be the only bidders on a piece of work fairly worth $1000. By prearrangement they submitted bids ranging from *A's* of $1800 to *D's* of $2000, and after the contract had been awarded to *A* he donated $150 to each of the others and still cleared $350 himself, over and above a legitimate profit. (Could *B*, *C* and *D* collect their share if *A* refused to pay it?)

(*ii*) Straw bids. A firm may, through its employees, and with attempt to deceive, submit more than one bid.

(*iii*) Illegal or improper connection between the bidder or some of his subcontractors and certain public employees. This would of course apply only to public works contracts, and is sometimes specifically mentioned in the proposal.

(*c*) *Plans understood and locality examined.*

The Contractor may, after his proposal has been accepted, (perhaps even after the contract has been signed) claim to have misunderstood some important feature of the design. This would not constitute for him a legally valid excuse for not carrying out the terms of his proposal or contract. A statement, made in the proposal, that he has thoroughly examined the site, and that he comprehends the plans and specifications has, perhaps, a tendency to make a bidder cautious about bidding on work without this careful preliminary investigation.

(*d*) *Date for completion.*

There are three practices in this respect:

(*i*) If it is absolutely essential that the work be finished on a certain date, this date (preferably not the corresponding period of time) may be printed in the proposal form.

(*ii*) If the date of completion is relatively unimportant, a blank space may be provided in which each bidder may propose his own date. This makes the comparison of bids difficult. Who shall say, for example, whether *A's* bid to do the work for $5000 within ninety days is more or less favorable than *B's* bid to do it for $4000 within six months? This difficulty has sometimes been met, with greater or less success, by assigning an arbitrary money value to a day.

(*iii*) It is probably better, if the element of time is not a vital consideration, to ignore it altogether in the proposal, inserting later a definite and reasonable date in the contract, when it shall be executed.

(*e*) *Note that certified check* (*or other form of earnest money*) *accompanies.*

Here the bidder states:

(*i*) That security for a certain amount and of a certain form accompanies his bid.

(*ii*) That if his bid is accepted and he refuses to sign the contract within the required time he is willing to forfeit the security, otherwise it is to be returned to him (not, of course, until the successful bidder has signed the contract).

(*f*) *Agreement to furnish security.*

The bidder here makes a statement as to the nature of the surety bond he intends furnishing in case his bid is accepted. The amount has perhaps already been fixed for him (see Art. 13) either as a percentage of his bid or as a definite sum.

(*g*) *Signature.*

The proposal should be signed by the bidder (the principal) and the signature witnessed. In some instances an acknowledgment before a notary is required, and some require that the bidder mention in his proposal the names of any subcontractors to whom he proposes letting portions of the work.

17. Specimen Proposal.*

Itemized Proposal for ....

To the Superintendent of Public Works:

The undersigned hereby declare that........... the only person interested in this bid; that it is made without any connection with any person making another bid for the same contract; that the bid is in all respects fair and without collusion or fraud; and that no official of the State, or any person in the employ of the State, is directly or indirectly interested in the bid or in the supplies or work to which it relates, or in any portion of the profits thereof.

The undersigned also declare that he ha carefully examined the annexed form of contract and specifications and the drawings therein referred to, and will provide all necessary machinery, tools, apparatus and other means for construction, and do all the work and furnish all the materials called for by said contract and specifications and the requirements under them of the State Engineer, for the following sums, to wit:

(Then follow the itemized amounts.)

And ....will commence the work on or before...... 19 , and will progress therewith to its completion on or before ...... 19 , in accordance with the terms of the contract.

Accompanying this proposal is a draft or certified check for $, being 5 per cent of the amount of the proposal. This money shall become the property of the State if in case this proposal shall be accepted by the State through the Superintendent of Public Works the undersigned shall fail to execute a contract and furnish the surety required by the law within the time fixed; otherwise the said money is to be returned to the undersigned.

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* (Slightly condensed from N. Y. State Canal proposal form, 1907.)

Signature of person, firm or corporation making the bid.

....

....

P. O. Address, ...

Dated, ...19 .

The full names and addresses of all persons interested in this bid as principals are as follows:

....

....

....

18. Presenting the Proposal. — The proposal is put in a sealed envelope, properly addressed and endorsed. Accompanying the proposal, often not sealed with it but put in another envelope, are:

(*a*) The certified check (or other form of security required to insure the signing of the contract).

(*b*) (Sometimes.) The written consent of the bondsmen to serve as such.

(*c*) (Sometimes.) An affidavit as to the financial standing of bondsmen offered. This is called the "Justification of Sureties," and is not commonly necessary if surety is to be furnished by a reputable bonding company.

The student should realize that the making of a proposal and its acceptance constitutes the consummation of a contract. Why, then, require a certified check?

Suppose the successful bidder refuses to enter into contract, must he necessarily lose his certified check?

19. Awarding the Contract.

(*a*) Contracts for private work may of course be let to any bidder, and the other bidders' only cause for complaint would be the trouble and expense to which they might have been put.

(*b*) State and other laws require in relation to contracts for public work, either:

(*i*) That the work be let to the lowest bidder (sometimes qualified by the phrase "if at all"). Under such a law it would be possible for the lowest bidder to enter suit if the contract were awarded to another.

(*ii*) That the work be let to the lowest *responsible* bidder. From the Engineer's viewpoint the latter is much the better plan, and should be followed where the laws permit. It is impossible to "coax first-class work from a third-class contractor," especially if he has taken the work at a low figure. Work let to an irresponsible contractor generally proves to be decidedly annoying to the Engineer and costly to the Owner. On the other hand, the indefiniteness of the word "responsible" leaves a loophole for unscrupulous officials.

20. Lump Sum and Unit Prices.

(*a*) Where the work to be done can be classified under a very few items and the exact quantities of each can be readily ascertained in advance, provision may be made for a contract based on an all-inclusive or lump sum figure. Where, however, there are many items and the quantity of work under each cannot be precisely foretold, unit prices will be simpler.

(*b*) Both would ordinarily involve about the same total cost, also the same amount of labor on the part of the Engineer. Each method has been used on important work. Unit prices are perhaps in more general use on large contracts.

The first contract for building the New York City subway ($35,000,000) was let on a lump sum basis; unit prices prevailed on the New York State barge canal contracts; while New York State highway contracts have been based on bids in which lump sum and unit prices were combined.

Which method of payment (lump sum or unit prices), and why, would be suitable in the case of a large and important dam? the superstructure of a steel bridge? several miles of railroad construction?

21. Unbalanced Bids.

(*a*) It is not necessary in a contract based on unit prices that the quantities under each item be measured in advance with precision. Carelessness in this respect on the part of the Engineer may, however, lead to the annoyance and extravagance of "unbalanced bids." *

Illustration: Suppose that it were required to make a certain deep excavation amounting to 5000 cubic yards, in connection with the grading of a tract of land. The Engineer in asking for bids based on unit prices states that they will be compared on the basis of his estimate that the excavation consists of 4000 cubic yards of earth and 1000 cubic yards of rock. When the bids are opened it is found that they compare as follows:

Estimated Quantities		*A's Bid*			*B's Bid*	
4000 cu. yds. earth............	@	$0.50	$2000	@	$0.05	$ 200
1000 cu. yds. rock............	@	$1.50	1500	@	$3.00	3000
			$3500			$3200

and the contract is awarded to *B*, whose bid is the lower, computed on the basis of his unit prices. Suppose further, that it is discovered as the work progresses that the relative amounts of earth and rock have been incorrectly estimated in advance and that when the work is finally completed *B* is entitled to payment as follows:

3000 cu. yds. earth at $0.05..........................	$ 150
2000 cu. yds. rock at $3.00..........................	6000
	$6150

or nearly twice his original figure.

It is readily seen that had the proportions of the two materials been known at the time the bids were compared, *A's* would have totalled as follows:

3000 cu. yds. earth at $0.50..........................	$1500
2000 cu. yds. rock at $1.50..........................	3000
	$4500

and the contract would have been awarded to him. The Owner therefore paid, assuming that *A's* unit prices were fair, $1650 more than the work should have cost.

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* Major Gillette says (*Engineering News*, 1907, vol. 57, p. 588), "Public treasuries have been robbed of untold millions by this simple device."

(*b*) A contractor would have an incentive for making an unbalanced bid only if it was his belief (founded perhaps on thorough local information) that the relative proportions in the Engineer's estimate would necessarily be departed from. Such might be the case in subterranean or subaqueous construction, or occasionally elsewhere.

(*c*) The submitting of unbalanced bids may be prevented, or discouraged, in one of five ways:

(*i*) State in the Information for Bidders that no unreasonable bid will be accepted. This allows argument as to the meaning of the word "unreasonable." Sometimes a maximum or minimum unit price, beyond which the bidder will not be allowed to deviate, is fixed in advance for each item.

(*ii*) Require lump sum bids only. This would probably prove more costly, as each bidder would have to do a certain amount of guessing, and he would be careful to protect himself. It might also involve difficulties in properly defining the work.

(*iii*) Print in the proposal a fair unit price covering each uncertain item. All bids on these particular items must then be identical. This plan has not been extensively practiced, and is not regarded favorably by the average contractor.

(*iv*) Let the Engineer prepare a list of unit prices based on his judgment of the relative cost of each class of work; and require of each bidder that each of his unit prices shall bear a fixed ratio (which the bidder determines, and which may be of course greater or less than unity) to the Engineer's unit figure for the same item.* This is called the percentage unit plan, and is in more common use abroad than in the United States.

(*v*) If at all practicable, the most advantageous plan is for the Engineer to make his preliminary investigations complete and exhaustive. Referring to the foregoing illustration, it is readily seen that a small fraction of the $1650 spent in making borings would have been well invested.

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* This plan may be so modified as to provide for the rejection of all bids in which any unit price differs more than a certain percentage from the standard fixed by the Engineer.

The student should prepare:

(*a*) A lump sum proposal for building either a concrete culvert, or a small steel bridge (including abutments), or an earth dam; or

(*b*) A unit price proposal for laying a system of sewer or water pipes of various sizes, or for constructing several miles of macadam road, or for grading a tract of ground.

In each case he may assume *all* necessary data. Each proposal should be completed in every detail, and enclosed, with all necessary accompanying papers, in a properly endorsed envelope.

CHAPTER V

THE COMPOSITION OF SPECIFICATIONS

Nowhere is the ability to express his thoughts in clear and forcible English more necessary to an Engineer than in the preparation of his specifications.

Specifications may contain stipulations which, if enforced, would work injustice to the Contractor.

22. The two most important requisites of specifications are *clearness* and *fairness*.

23. **Clearness.** — A specification has been facetiously defined as "an instrument or document whose purpose is to set the Contractor guessing at the meaning of the Engineer." Specifications many times require interpretation under unfavorable weather conditions and at the hands of unlettered men. The meaning of a sentence in the classics (a purely academic question) has not infrequently been made a subject for acrid and protracted argument. The precise meaning of a sentence in a specification should admit of no argument, as it may vitally affect the peace of mind and the fortunes of many individuals. Each sentence should therefore be so framed that no reasonable person could read into it any meaning other than that intended by the author.

Major Gillette cites the following (*Engineering News*, 1907, vol. 57, p. 587). "An engineer first wrote his specifications calling for different prices for excavation at different depths, clearly expressed as so much for 'less than 6 feet' so much 'between 6 and 10 feet' and so on. He revised the specification to read so much for 'excavation less than 6 feet,' and so much for 'excavation less than 10 feet,' and so much for 'less than 14 feet,' leaving it doubtful whether or not separate prices were to be paid for different depths at the same place in a deep trench. That Engineer's client, a municipality, lost at least $180,000 on that contract, largely made possible by that change from clearness to vagueness."

The author recalls the following sentence which he once found in sewer specifications, "After the pipe is laid the trench shall be filled in with shovels." Whether or not the stipulation was interpreted literally he never knew.

24. **Rules for Clearness.*** — Observance of the following elementary rules, most of them applying with equal force to any technical composition, will lead to a degree of clearness in specification writing.

(*a*) *Prepare an outline.* Anyone who attempts an extended piece of literary composition feels at once the need of an outline. This need is emphasized in the case of such a document as a set of specifications, — it is impossible to write them without a complete and carefully prepared outline, which is designed to prevent:

(*i*) Repetition, in the specifications, as well as duplication between contract and specifications.

(*ii*) Contradiction, a far more serious defect, often growing out of the former, and one that has led to many a serious legal tangle.

(*iii*) Omission. All portions of the specifications are of course not of equal importance. A few are of such moment that their absence may seriously impair the usefulness of the entire document.

(*iv*) Illogical arrangement. This applies more particularly to the specific clauses. (See Art. 61.)

(*b*) *Do not use long sentences.* A period, judiciously used midway, may clear up the meaning of a sentence apparently obscure and involved.

(*c*) *Use commas sparingly.* Courts have been known to ignore their presence. Above all, do not construct a sentence in such form that the addition, omission or misplacement of a comma could alter the sense.

"The Contractor said the Engineer was wrong." The addition of two commas reverses the meaning. The omission of a comma in a copy of the laws of the State of Pennsylvania recently furnished grounds for a suit resulting in the award of $850 damages.

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* The student will find the study of such books as Frost's "Good Engineering Literature" and Earle's "Theory and Practice of Technical Writing" a valuable preparation for the composition of clear specifications.

(*d*) *Avoid the use of many-syllabled or high-sounding words.* A book of synonyms will be useful. Be careful to use technical words in their exact technical meaning; if there is any doubt put in a word of explanation. In the choice of words it is well to restrict yourself to those likely to be included in the vocabulary of an ordinarily intelligent foreman.*

(*e*) *The use of pronouns, especially of relative pronouns, should be reduced to a minimum.* It is better to repeat the noun even at a sacrifice of elegance.

(*f*) *Give directions, not suggestions.* Tell the Contractor what he shall or shall not do, not that he should or should not do it. Architect's specifications are often so abbreviated as to contain very few complete sentences. "Plaster on hallways to be ....," etc. Fortunately the practice has not extended to engineering specifications.

(*g*) *Aim to make your language crisp and concise.* Do not strive for elegance of style or for the effect of a flow of words.

Until the past few years the language of specifications was to a great degree modelled after that commonly used in legal documents — some of it verbose in the extreme. Many of these wordy expressions may be traced back to the days when compensation for drawing up legal papers was largely dependent on the number of words they contained. The efforts of a number of clear-headed writers among the engineering profession have brought about a decided improvement in this direction, and many of the newer specifications are models of concise expression.

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* To quote from "Life":—"*Use Short Words.* Literary aspirants should religiously eschew polysyllabic orthography. The philosophical and philological substructure of this principle is ineluctable. Excessively attenuated verbal symbols inevitably induce unnecessary complexity and consequently exaggerate the obfuscation of the mentality of the peruser. Conversely, expressions which are reduced to the furthermost minimum of simplification and compactness, besides contributing realistic verisimilitude, constitute a much less onerous handicap to the reader's perspicacity. Observe, for instance, the unmistakable and inescapable expressiveness of onomapoetic, interjectional, monosyllabic utterances, especially when motivated under strenuous emotional circumstances. How much more appealing is their euphonious pulchritude than the preposterous and pretentious pomposity of elongated verbiage."

The following is quoted from Frost's "Good Engineering Literature," pp. 50, 51:

" . . . Even in specifications, in the preparation of which conciseness is second only to clearness, superfluous clauses are by no means uncommon, as, for instance, in the following clause taken from a printed set of specifications:

"'It is expressly specified that in entering into the agreement to perform the work herein specified, the Contractor admits that he has read each and every clause of these specifications and the circular of instructions, fully understands the meaning of the same, and that he will comply with all the requirements herein set forth.'

"Here fifty words have been used to say — what? Merely that the Contractor who has signed the contract has read its requirements — an assumption that is implied by the act of signing the contract. The clause is wholly superfluous on that account, but leaving aside any such legal considerations, consider only the wording of the clause. There is no need of saying that anything is 'expressly' specified in a specification. Everything in a specification is 'specified' and nothing is any more 'expressly specified' than anything else. The words 'in entering into this agreement to perform the work herein specified,' add nothing to the clearness or scope of the clause, for the specification certainly relates to no work outside the work 'herein specified'. Again, 'the Contractor admits that he . . . fully understands the meaning of the same'. Aside from the fact that it is hard to understand how a man can 'admit' that he understands, it is unnecessary for the Contractor to say so, as his signature 'admits' that. Finally, 'he will comply with all the requirements herein set forth'. Of course he will. What are the specifications and contract for if not to insure compliance with their requirements? And being so, there is not the slightest need of using even ten words to state the fact."

The student may criticize and reconstruct the following:

(*a*) "During a period of ten calendar days following and subsequent to the day it is put in place the Contractor shall moisten or cause to be moistened with pure water each and every portion of the concrete which is or may be deposited by him or by his employees under the terms and conditions of this contract."

(*b*) "Water used for commingling the component parts of concrete shall be hydrogen monoxide of such a degree of absolute purity that a rigid analysis shall show not more than a bare trace of volatile oils, grease, organic matter, mineral salts or other objectionable impurities."

(*c*) "The wall shall be built by the Contractor to lines and grades given by the Engineer, and each and every stone before it is laid in place shall be inspected by him."

25. Fairness. — A reputation for fair dealing is among an Engineer's most valuable assets, worth to him in the long run far more than a reputation for extraordinary ability or for cleverness. Many cases of unfairness have arisen from inexperience on the Engineer's part. The relation of the Engineer to the other persons concerned with construction work is a peculiar one. He is employed and paid by one party to the contract (the Owner), and expected to act impartially and fairly toward both. It is sometimes argued, and not without some reason, that the Engineer should be paid in part by both Owner and Contractor. In a certain sense, the Engineer's position is legislative, executive and judicial. He prepares the specifications, sees that the design is executed and explains any ambiguities or settles any disputes.

The following extract from a recent writer is *not* to be taken as representing the broadest view of the relations of the Engineer to the Contractor: "The Engineer is in the interests of the Proprietor, and receives his compensation from him. . . . He is not required nor expected to watch the Contractor's business nor to promote his interests, and any attempt to do so might render his position untenable, change the relations of the parties, and render the stipulation of his choice invalid. . . . The Engineer owes no duties to the Contractor except what he can demand by the terms of his contracts; he is under no obligations to protect his interests or assist him in his affairs."

26. Fair Specifications. — It may at first seem that the opportunity for the exercise of fairness comes to the Engineer only after the work of construction has commenced. On the contrary, his treatment of the Contractor begins when he prepares the specifications. Reference to recent numbers of the engineering periodicals will disclose the fact that the written complaints of contractors are directed not so much against how the Engineer interprets his specifications, as against some supposedly unfair clauses which the specifications contain. Four faults need to be guarded against by the beginner in this connection:

(*a*) *Avoid the use of indefinite words and phrases.* The natural implication in the case of an all too free use of phrases like "as the Engineer may direct," "to the satisfaction of the Engineer," "acceptable to the Engineer," "a workmanlike job," "about" (the adverb), etc., may be:

(*i*) That the Engineer has not made a sufficiently exhaustive study of the details to be able to describe exactly what he wants; or

(*ii*) That a contractor who is acquainted with the temperament and previous rulings of the Engineer has an unfair advantage over one to whom the Engineer is a stranger.

To quote again from Major Gillette (*Engineering News*, 1907, vol. 57, p. 587).

"The writer has known a contract in which there was necessarily reserved for the Engineer discretionary action on nineteen different matters of importance. Exercised unfavorably, his discretion could increase the cost to the Contractor at least 50 %. Under these circumstances, though the contract was a large one, it is remarkable that there were only two bidders, and they were 'old friends' in bidding. The Engineer's estimate for this work was three million. The Contractors got over five. In another contract a certain privilege was denied the Contractor, except with the approval of the Engineer. Before a stroke of work had been done by the favored Contractor the Engineer gave his approval. It was worth to the Contractor $107,000.00 in cold cash.

"The writer once investigated a case where the Contractors in collusion with the Engineer fraudulently received about $2,600,000.00 above fair profits through a provision in the specifications requiring the bidder to submit one price for three different constructions, to be used '*at the option of the Engineer.*' The Contractors and the Engineer concerned have all since been sentenced to the penitentiary."

(*b*) *Do not attempt to throw all risks on the Contractor's shoulders.* It is never wise, and may be unfair and expensive as well. (See Arts. 42–47.)

(*c*) *Warn the Contractor* (*in the specifications*) *of any particular danger likely to be encountered.*

The ability to prepare specifications which will bring in low bids is not always to be coveted, and serious trouble to Owner or Engineer may result if an attempt has been made at concealment.

(*d*) *Do not put anything in the specifications unless you mean to enforce it.* Do not add a clause simply for use in an emergency as a club, it may prove to be a boomerang and injure the Engineer when he least expects it.

Allowing the Contractor, after the contract is signed, to substitute something "just as good" is neither fair to the other bidders nor good for the Engineer's reputation. There are of course circumstances where a concession in price on the part of the Contractor may alter the situation. The acceptance of a *method* other than that prescribed is discussed in Art. 67.

CHAPTER VI

GENERAL CLAUSES

Specifications and Plans

The purpose of the General Clauses has already been discussed, in Chapter II. Several extracts (denoted by the letters *A*, *B*, *C*, etc.) from actual specifications will be found at the close of each article in this Chapter, also throughout Chapters VII, VIII, IX, X and XI. While all of these conform to the best practice, they have been culled from many different sources and the variations in phraseology and style are very marked. Critical study and comparison of these typical clauses should be made by the student.

The following group of six General Clauses relates to the specifications and plans themselves: the meaning of some of the terms used: the making of alterations in either: the treatment of any inconsistencies which may appear; and the placing of responsibility for data they contain.

27. What the Plans and Specifications Include. — This group of clauses often opens the specifications.

(*a*) The *work* they are intended to *describe*. Under this head a concise summarized description of the work should be given, noting in particular exactly where it begins and ends and sharply differentiating it from work covered by any other contract, existing or contemplated.

(*b*) *What* they *comprise*. Note especially the number, character, titles and dates of any drawings already executed. Describe any yet to be made, whether by Engineer or Contractor.

> (*A*) The work herein described consists of .... from .... to .... The complete specifications are contained in the following pages. The plans comprise ...... sheets numbered ...., (attached hereto), each entitled ...., signed by............ and dated ....

28. Definitions. — The defining consists not in giving accepted or dictionary definitions but in limiting the meanings of words or phrases which are to be used throughout the specifications. Two purposes are thereby served: *First,* minimizing the possibility of misunderstanding or argument.

Second, saving space in the specifications.

(*a*) *Contractor.* The necessity for limiting the meaning of this word arises from the fact that two or more Contractors are frequently engaged in work covered by the same contract. In directing the work the Engineer may, and frequently does, give informal instructions to any Contractor who may be engaged in constructing the particular portion of the work in question. Formal directions, in writing, should be addressed however only to the Contractor who has signed the original contract with the Owner. The purpose of this limitation is to avoid any attempted shifting of responsibility, and its attendant confusion.

The clause should be so framed as to recognize the fact that the Contractor may by "Power of Attorney" papers delegate to any person the authority to act as his agent in many capacities. See references under "Agency" in books on Contract Law.

Suppose the Contractor dies before his contract is completed, to whom thereafter does the word Contractor refer? What is power of attorney?

(*b*) *Owner.* This clause would hardly be necessary if the Owner were an individual. But where the work is being done for a city, for example, and the word city is used frequently in the specifications, it may be well (since it is obviously impossible that the work shall be done to the expressed satisfaction of more than a small fraction of the inhabitants) to state at this point just which officers of the city the word is intended to include.

Suppose that, while a municipal contract is in progress, the entire Board of Aldermen (or whatever board has in charge the matter of public works contracts) is replaced by others elected to fill their places, or is even legislated out of existence by a revision of the charter. To whom is the Contractor then bound by the terms of his contract? Discuss the case of the death of the Owner (an individual).

(*c*) ***Engineer.*** To avoid misunderstanding on the part of anyone concerned it is advisable to state at this point just who is meant by the frequently recurring term "Engineer." Does it mean the Resident Engineer or one of his assistants, or the Division Engineer, or the Chief Engineer, or the Consulting Engineer? The reference is generally to the one highest in authority, who deals directly with the Owner. He (the Engineer), as well as the Contractor, commonly delegates portions of his authority to his subordinates, thereby making himself liable in that degree for their rulings.

(*d*) *Other terms.* Specifications for some classes of work make frequent use of certain expressions the precise meaning of which could constitute a subject for argument or misunderstanding. Such might include various units, as "ton," "day," "cubic yard," "earth," "rock" (see Art. 62); also such expressions as "clearing," "grubbing," etc.; also such abbreviations as "acceptable," "directed," "required" and the like. (See Art. 26.)

(*A*) Whenever the following words and expressions, or pronouns used in their stead, occur in these specifications, they shall have the meanings here given:

The word "Contractor" shall mean the party or parties entering into the contract for the performance of the work covered by these specifications, and his or their authorized agents or legal representatives.

The word "City" shall mean the corporation of the City of.......... The words "Commission" shall mean the .... Commission of the City of ...., and any other board, body, official or officials to which or to whom the powers belonging to the said Commission shall, by virtue of any act or acts, hereafter pass or be held to appertain.

The word "Engineer" shall mean the person holding the position or acting in the capacity of Chief Engineer of the .... Commission, acting either directly or through his properly authorized agents, such agents acting within the scope of the particular duties entrusted to them.

Whenever in the specifications the words "as directed," "as required," "as permitted," or words of like effect are used, it shall be understood that the direction, requirement, or permission of the Engineer is intended; similarly the words "approved," "acceptable," "satisfactory," or words of like import shall mean approved by, or acceptable or satisfactory to, the Engineer.

29. **Alterations.** — This question is a large and important one, at least theoretically. By strict interpretation of the law the making of any important alteration in design after the signing of the contract vitiates the agreement and releases both parties to the contract, together with the bondsmen.

A contract for building a road of crushed limestone, for example, is not a contract for building one of crushed trap rock.

In practice this would almost never be insisted on. The Engineer should, however, consult the Owner's legal adviser before suggesting alterations in the design, and should be cautious about making any alterations except minor ones which are unquestionably betterments. The substance of such a clause should include three points:

(*a*) Giving the Engineer the authority to make such reasonable changes in plan or specifications as he shall see fit.

(*b*) Providing a method of adjusting the difference, if any, in cost. (Precluding any allowance, in case of a change involving decreased cost, for anticipated profits not realized.)

(*c*) Stipulating that changes shall not affect the contract, or bond. (See Arts. 7, 11.)

It should be remembered that written matter in an agreement prevails over printed matter; why? also that written matter of any importance should be signed, and dated.

(*A*) This contract, and the specifications herein contained, and the plans herein referred to, may be modified and changed from time to time as may be agreed in writing between the parties hereto, in a manner not materially affecting the substance thereof or materially changing the price to be paid, in order to carry out and complete more fully and perfectly the work herein agreed to be done and performed.

(*B*) The right is reserved by (the Owner) to make such changes in the plans and specifications as may from time to time appear necessary or desirable and as may be recommended by the Engineer, and such changes shall in no wise invalidate the contract. Should such changes be productive of increased cost to the Contractor a fair and equitable sum therefor, to be agreed upon in writing before such changed work shall have been begun, shall be added to the contract price, and in like manner deduction shall be made. No allowance will be made for anticipated profits.

30. Inconsistencies and Omissions.

(*a*) Many cases involving inconsistencies between plans and specifications have found their way to the courts. A recognized axiom of law covering similar situations is that the Court shall ascertain, if possible, the "intention of the parties" to the contract, and that this shall prevail.

(*b*) Referring to Art. 9 it is seen that the purpose of the specific clauses in the specifications is to supplement the plan. It cannot be expected, therefore, that all of the features of the design shall be described in both places. In order that there may be no doubt or room for dispute on this point it is always stated in the specifications,

(*i*) that the plans and specifications are to be interpreted as mutually explanatory or supplementary, and that therefore any feature shown on one and not on the other shall have the same force and effect as if shown on both. It is generally added,

(*ii*) that anything necessary to the proper completion of the work, even though neither shown on plans nor mentioned in the specifications, shall be done by the Contractor without extra charge. This would apply merely to something essentially and vitally necessary and unmistakably implied.

For example, the digging of a trench in which to lay a sewer pipe five feet underground might be necessarily implied in the agreement to lay the pipe; but the constructing of an artificial foundation under the pipe (in case the subsoil were found to be soft) would not. Similarly the use of forms would be implied in many varieties of concrete construction, while the use of any type of reinforcement or the dressing of the surface after the forms had been removed would not be.

The question of guaranteeing the "sufficiency of the plans"* is of interest here. To illustrate: A contractor builds a stone arch bridge, which falls as soon as the centers are removed. Inspection has been adequate and the Engineer has made no complaint that the Contractor was not performing his work faithfully. Who is responsible?* As a rule the Contractor would be obliged, in order to escape responsibility, to prove that his work had been faultless. Court decisions on the question have been somewhat conflicting. The student may investigate this feature of the failure of the Quebec Bridge (Aug. 29, 1907.)

Would a firm which built pumping engines furnish a pump constructed in accordance with minute detailed plans furnished by an Engineer and guarantee it to deliver a definite amount of water per day? Discuss the case of a steel company erecting a bridge and guaranteeing the load it will carry.

(*A*) It is hereby agreed that these specifications and the accompanying plans are intended to coöperate, so that any matter or thing shown by one and not by the other shall be of the same effect as if contained in or shown by both and shall be performed by the Contractor without extra charge.

(*B*) The plans and specifications are intended to be explanatory of each other, but should any discrepancy appear or any misunderstanding arise as to the import of anything contained in either, the explanation of the Engineer shall be final and binding on the Contractor, and all directions and explanations required, alluded to, or necessary to complete any of the provisions of such specifications and give them due effect, will be given by the Engineer.

* See "Code of Khammurabi" (Art. 42).

(*C*) These specifications and the accompanying plans are intended to require and include all work and material necessary and proper for the work contemplated. In case by inadvertence or otherwise, the plans or specifications omit to require some work or material necessary for that purpose, the Contractor shall, nevertheless, be required to provide the same so that the work may be complete according to the true intent and purpose of the plans and specifications.

31. Verification of Data. — In how far should the Contractor be expected to accept the responsibility for data furnished him by the Engineer?

To illustrate: Plans for a pile and timber dock show hard bottom underlying eight feet of mud. The Contractor bases his bid on this information, but finds as construction progresses that the supposed hard bottom is only a thin layer of gravel. Can he be held to complete the dock at a greater expense to himself than was originally contemplated?

One of two courses is open to the Engineer in preparing specifications for work involving uncertain preliminary data:

(*a*) To throw the responsibility of verification on the Contractor. In the above illustration it might have been easy for the Contractor to make the necessary preliminary investigation, and he would have been the more likely to do it if the Engineer had so worded the statement in the plan or specifications as to make it appear that he was stating, not a fact, but what appeared to him to be a fact.

(*b*) To assume the responsibility for data furnished. There are instances where the compilation of the data given on the plans represents weeks and months of patient investigation on the part of a large engineering force. For the Engineer under these circumstances to disclaim responsibility and expect the Contractor to verify all data furnished him is certainly unreasonable. Mr. John C. Wait (*Eng. News*, 1905, vol. 53, p. 595) quotes and commends a rather unique specification clause in which it is stated that the Engineer had investigated the strata and knew the situation to be as represented, but that if it should prove otherwise the Owner would make good the Contractor's loss. Failure to mention this responsibility has many times resulted in situations like the following (although court decisions vary somewhat):

United States Government engineers prepared plans and specifications for dredging a river in New England, stating in the specifications that the material to be moved consisted largely of sandy mud mixed with a little gravel. As the work progressed the Contractor found the supposed sand and gravel to be instead a stiff clay. He abandoned the work after a time, and was awarded damages by the Court of Claims.* (See Art. 43 for other illustrations.)

(*A*) The material to be removed is believed to be ...., but bidders are expected to examine the work and to decide for themselves as to its character and to make their bids accordingly, as .... (the Owner)........ does not guarantee the accuracy of the description.

(*B*) It is understood and agreed that the quantities given in these specifications are approximate only, and that no claim shall be made against .... (the Owner) .... on account of any excess or deficiency, absolute or relative, in the same. No allowance will be made for the failure of a bidder or of the Contractor to estimate correctly the difficulties attending the execution of the work.

(*C*) The Contractor agrees that he has satisfied himself by his own investigation and research regarding all the conditions affecting the work to be done and labor and material needed, and that his conclusion to execute this contract is based on such investigation and research, and not on the estimate of the quantities or other information prepared by the Engineer, and that he will make no claim against .... (the Owner) .... because any of the estimates, tests or representations of any kind affecting the work made by any

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*** What is the Court of Claims, and why has it a peculiar interest to engineers and contractors?**

agent of .... (the Owner) .... may prove to be in any respect erroneous.

(*D*) The quantities of work to be done and the materials to be furnished under this contract are estimated, as herein stated, approximately only, and .... (the Owner) .... is not to be held responsible for the data or information relative to the Engineer's Estimate of Quantities. The Contractor has judged for himself as to such quantities and each of them, and as to other circumstances affecting the costs of the performance of this contract, and as to the accuracy of this estimate, and he will not at any time assert that there was any misunderstanding in regard to the depth of the excavations to be made, or the nature, kind or amount of materials to be furnished for the work to be done. And he will not ask, demand, sue for, or seek to recover, for materials furnished or work done under this contract, any compensation beyond the amounts payable for the different classes of work herein enumerated, which shall be actually performed at the prices therefor, herein agreed upon and fixed.

32. **Copies Kept on Work.** — This is largely a clause of convenience to the Engineer, but is designed also to induce care on the part of the Contractor.

(*A*) Copies of the plans and specifications shall at all times be kept on file by the Contractor at readily accessible points along the line of the work.

CHAPTER VII

GENERAL CLAUSES

The Engineer During Construction

The subject matter of the General Clauses considered in this Chapter relates to the Engineer's decisions, his authority, and to superintendence or inspection in general.

33. Decision of the Engineer.

(*a*) On construction work, after the contract has been signed, the principal duties of the Engineer (many of these of course delegated by him to proper subordinates) are:

(*i*) To lay the work out, fixing necessary lines, elevations, etc.

(*ii*) To make such measurements as will determine payments to the Contractor.

(*iii*) To interpret the plans and specifications, in case of any real or seeming ambiguity.

(*iv*) To see that the materials and workmanship furnished by the Contractor are in conformity with the design.

Superintendence on the part of the Engineer must have been rather lax among the ancient Romans, if we are to judge from the following correspondence dating from the year 152 A.D. (Mauretania and Numidia were neighboring Roman colonies in Northern Africa.)

"*Varius Clemens, Governor of Mauretania, to Valerius Etruscus, Governor of Numidia:*

Varius Clemens greets Valerius Etruscus, and begs him in his own name and in the name of the township of Saldæ, to dispatch at once the hydraulic Engineer of the third legion, Nonius Datus, with orders to finish the work, which he seems to have forgotten."

"*Report of Nonius Datus to the Magistrates of Saldæ:*

After leaving my quarters I met with brigands on my way, who robbed me of even my clothes, and wounded me severely. I succeeded, after the encounter, in reaching Saldæ, where I was met by the governor, who, after allowing me some rest, took me to the tunnel. There I found everybody sad and despondent; they had given up all hopes that the two opposite sections of the tunnel would meet, because each section had already been excavated beyond the middle of the mountain, and the junction had not yet been effected. As always happens in these cases, the fault was attributed to the Engineer, as though he had not taken all the precautions to insure the success of the work. What could I have done better? I began by surveying and taking the levels of the mountain; I marked most carefully the axis of the tunnel across the ridge; I drew plans and sections of the whole work, which plans I handed over to Petronius Celer, the governor of Mauretania; and to take extra precaution, I summoned the Contractor and his workmen, and began the excavation in their presence, with the help of two gangs of experienced veterans; namely, a detachment of marine infantry and a detachment of Alpine troops. What more could I have done? Well, during the four years I was absent at Lambaese, expecting every day to hear the good tidings of the arrival of the water at Saldæ, the Contractor and his assistant had committed blunder upon blunder; in each section of the tunnel they had diverged from the straight line, each toward his right, and had I waited a little longer before coming, Saldæ would have possessed two tunnels instead of one." — For the outcome of the case the student is referred to Lanciani, "Ancient Rome," p. 61; or his "Frontino," p. 544; or "C.I.L.," viii., 2728; or to Herschel, "Frontinus and the Water Supply of the City of Rome," p. 179.

(*b*) The clause referring to the decision of the Engineer is one of the vital clauses in the specifications. While it is customary so to word the specifications as either tacitly or expressly to put all four of the above matters entirely in the hands of the Engineer, the fact should be recognized that it is easily possible to draft a clause giving the Engineer so much power or authority that, if the terms of the contract were to be literally enforced, the Contractor would become simply an agent of the Owner. This situation is particularly to be avoided. Under the first head (laying out), so far as concerns simply questions of fact, it is unlikely that any serious or long continued dispute could arise. The question of payments (discussed in Chapter XI) is somewhat complicated at times with questions of extra work and of classification of material. The latter two points (interpretation and supervision) also involve many matters concerning which opinions might differ.

(*c*) On a very few important pieces of construction work provision has been made for a Board of Arbitration, to which board either Contractor or Owner might appeal if dissatisfied with certain of the decisions of the Engineer which were based on his judgment or opinion. This Board in most cases has consisted of three persons, one selected by each party to the contract and the third by the other two.* Since such boards are expensive, and more often than not reduce themselves, in effect, to this third man, some few contracts have been so drawn as to provide instead for appeal to a single Arbitrator, generally an Engineer of recognized standing and probity.

(*d*) It must be remembered, however, that a contract agreement to abide by the judgment or decision of a Board of Arbitration, or of a single Arbitrator, is no more binding on either party to the contract than is a similar agreement to abide by the judgment or decision of the Engineer. In other words, nothing of the sort could restrain either the Contractor or the Owner from taking the matter to the courts if he felt he had a grievance.

But, should either Contractor or Owner seek to have a decision of the Engineer (or of a Board of Arbitration) overruled by the courts, it would be incumbent on him to prove that the decision in question was arrived at as the result of gross incompetence, dishonesty, bias or unfairness. It is therefore comparatively seldom that such matters find their way to the courts. The clause should preferably read "To prevent all disputes," rather than "In case of dispute."

The student should comment on the following clauses:

(*i*) From *sewer* specifications. "The Engineer in charge shall generally interpret the specifications and detail plans of the work, but should any question arise as to the true meaning, the decision of the Sewer Committee shall be binding and conclusive."

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* In a uniform building contract recently (1911) adopted by several organizations of Chicago engineers and architects, provision is made for naming the third arbitrator in the contract.

It is very seldom, even where a Board of Arbitration is provided for in the specifications, that any matters are actually referred to it for settlement. The arbitration principle has been much more fully developed in England than in the United States.

(*ii*) From *dry-dock* specifications. "The United States by its Civil Engineer in charge of the work or his authorized representative, shall at all times have full control and direction of all work under the contract."

(*iii*) "To prevent all suits and litigations it is further agreed by and between the parties to this contract that the Engineer shall in all cases determine the amounts of work done which are to be paid for under this contract; that he shall be the sole judge of the manner of construction, of the quality of the materials and of the interpretation of the specifications; that he shall decide all questions which may arise relative to the carrying out of this contract; and that his estimate of figures, measurements, directions and decisions shall be final and conclusive, neither party to this contract having recourse to the courts or to the opinion of other experts."

(*iv*) "The Engineer shall have entire charge of all forces employed under this contract, and shall direct their work and disposition, and shall order such forces increased or diminished as he shall deem expedient."

(*A*) All the work done under this contract shall be done to the satisfaction of the Engineer, who shall in all cases determine the amount, quality, acceptability and fitness of the several amounts of work and materials which are to be paid for hereunder, and shall decide all questions which may arise as to the measurement of quantities and the fulfillment of this contract on the part of the Contractor, and shall determine all questions respecting the true construction or meaning of the plans and specifications, and his determination and decision thereon shall be final and conclusive; and such determination and decision, in case any question shall arise, shall be a condition precedent to the right of the Contractor to receive any money hereunder.

(*B*) To prevent disputes and litigation the Engineer shall in all cases determine all questions which may arise as to the quality, character or quantity of the work and materials to be paid for under this contract, or as to the obligation of the Contractor to do any particular work or to furnish any particular materials, or as to the reasonable value of any additional work or materials required by the Engineer, or as to the deduction to be made from the contract price for the construction of the ...., by reason of any work or materials directed by the Engineer to be omitted, or as to the price to be paid for any duly authorized and ordered extra work, and any and all disputes, questions or doubts of whatever nature relative to the contract or to the obligations of the Contractor hereunder. His determination shall be final and binding on the Contractor and .... (the Owner) ...., except as hereinafter provided; and the Contractor shall in all cases where an appeal from the decision of the Engineer is provided and allowed herein, proceed or refrain from proceeding as the case may be, and without any delay obey the requirements of the Engineer pending such appeal. In case any question shall arise between the Contractor and .... (the Owner) .... touching the contract, the estimate and decision of the Engineer shall be a condition precedent to the right of the Contractor to receive any moneys under the contract. A determination or decision of the Engineer shall not be finally conclusive however upon either the Contractor or .... (the Owner) .... as to the reasonable value of work or materials additionally required as aforesaid, or omitted as aforesaid, or as to the price to be paid for any duly authorized extra work or as to the obligation of the Contractor to furnish or do, as part of this contract, any particular material or work required by the Engineer, or as to the question whether .... (the Owner) .... is entitled to a deduction from the amount payable to the Contractor on account of any reduction in the amount of work to be done which may be ordered by the Engineer as herein provided, or as to the amount of such deduction. In every such case .... (then follows an outline of the procedure necessary in case either Owner or Contractor wishes to appeal from the decision of the Engineer to that of a Board of Arbitration).

34. **Inspector.** — The author believes that the less said in the specifications as to the powers and duties of the inspector the better; that he should be mentioned, if at all, merely as a representative (or agent) of the Engineer; and that whatever power he has to accept or reject should be regarded simply as having been delegated to him by the Engineer. Many specifications state, for the Contractor's benefit, that one or more inspectors will be appointed. This seems unnecessary, except perhaps where he is to inspect the manufacture of material.* It is not infrequently provided that no work shall be done in the inspector's absence.

Has the Engineer power to accept what the inspector has rejected, or vice versa? If he has this power should he use it and, if so, when?

(*A*) An inspector employed by ...... (the Owner) ...... may be stationed by the Engineer on the work under contract to report whenever the Contractor appears to fail in carrying out the terms of the contract or specifications in any particular. Any advice which an inspector may give the Contractor shall in no wise be construed as binding the Engineer in any way or releasing the Contractor from the proper fulfillment of the terms of the contract as determined by the Engineer. An inspector shall perform such other duties as the Engineer may indicate, but no inspector shall in any case act as foreman for the Contractor or interfere with the management of the work by the Contractor.

(*B*) All material furnished under this contract will be subject to rigid inspection. The Contractor shall furnish free of cost the necessary test pieces and complete facilities including the necessary labor for the inspection and testing of all material and workmanship. The Engineer shall at all times have full access to all parts of the shop where material under his inspection is being manufactured. Inspection of the work done shall not relieve the Contractor of his obligation to furnish proper material and perform sound and reliable work.

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* Certain specifications — as those for important steel structures, for wooden block pavements, etc., — contain provision for inspection of material at its place of manufacture.

35. **Rejected Material.** — Material which is unsatisfactory and not conforming to the specifications is rejected, and it should be made the duty of the Contractor to remove the rejected material from the work immediately. It is only proper that this material should be branded, — if possible in such way as to make its identification easy in case the Contractor should attempt to smuggle it back. The rejected material still belongs, however, to the Contractor, and its usefulness to him for other purposes should not be impaired.

When is material accepted — when it is delivered on the work or not until it is built in? When does it cease to be the property of the Contractor?

(*A*) Any materials condemned or rejected by the Engineer as not conforming to these specifications may be branded or otherwise marked, and shall, on demand, be at once removed by the Contractor to a satisfactory distance from the work.

(*B*) If any materials used in the work, or brought upon the ground, or selected for use in the work, shall be condemned by the Engineer on account of bad or improper workmanship, or as being unsuitable or not in conformity with the specifications, the Contractor shall forthwith remove from the work and its vicinity, without delay, all such rejected or condemned material of whatever kind, and upon his failure to do so within forty-eight (48) hours after having been so directed by the Engineer, the condemned material may be removed by .... (the Owner) .... and the cost of said removal deducted from any money that is then due or that may thereafter become due to the Contractor on account or by virtue of his contract, and no payment shall be made until such material, work or workmanship has been removed and proper materials and workmanship substituted therefor.

36. Unnoticed Defects.

(*a*) The aim and intent of the contract is that the Contractor shall furnish the Owner with a structure conforming in every detail with the design. The Engineer's final certificate should state that such a structure has been furnished. His progress certificates should not, as a rule, imply the absolute acceptance of any part. In other words, the structure is not formally turned over by the Contractor to the Owner as completed until the date of the final certificate of the Engineer. (See Art. 58.)

(*b*) In order to make this point (which is commonly understood) doubly clear it is customary to write in the specifications that the failure of the Engineer to condemn unsatisfactory work at any point shall not relieve the Contractor of his obligation to furnish work and material in accordance with the specifications, and that any defects, previously unnoticed, shall be corrected by the Contractor whenever, previous to the issuance of the final certificate, they shall be called to his attention by the Engineer.

(*c*) Certain specifications go further than this in reference to defects whose existence is only suspected, on account of their having been covered by subsequent work, stipulating that if, in such instance, the defect is found to exist, the expense of investigation shall be borne by the Contractor, otherwise by the Owner.

(*A*) Material that does not conform to the specifications accepted through oversight may be rejected at any stage of the work.

(*B*) Any defective work or material that may be discovered by the Engineer before the final acceptance of the work or before final payment has been made shall be removed and replaced by work and material which shall conform to the spirit of the specifications; failure or neglect on the part of the Engineer to condemn or reject bad or inferior work or materials shall not be construed to imply acceptance of such work or materials.

(*C*) Whenever required by the Engineer the Contractor shall furnish all tools, labor and materials necessary to make an examination of any work completed or in progress under these specifications. Should such work be found defective, the cost of making such examination and of satisfactory reconstruction shall be borne by the Contractor; should the work be found to be satisfactory the cost to the Contractor of the examination will be paid by .... (the Owner) ....

37. **Reception of Engineer's Directions.** — It is not to be expected that the Contractor will be constantly present on the work. Contracts have been satisfactorily completed in which the Contractor was absent practically throughout. During his absence however there should always be on the work some person authorized by him to receive and execute the directions of the Engineer.

(*A*) Whenever the Contractor is not present on any part of the work where it may be desired to give directions, orders shall be given by the Engineer, and shall be received and obeyed by the superintendent or foreman who may have charge of the particular work in reference to which the orders are given.

(*B*) The Contractor shall give his personal supervision to the faithful prosecution of the work and in case of his absence he shall have a competent representative or foreman on the work who shall follow without delay all instructions of the Engineer or his assistants in the prosecution and completion of the work and every part thereof, in conformity with this contract, and who shall have full authority to supply men, material and labor immediately.

CHAPTER VIII

GENERAL CLAUSES

The Contractor and His Workmen

The Contractor's obligations in respect to his workmen are outlined in the General Clauses in this Chapter.

38. **Sanitary Provisions.** — If the work is located in close proximity to dwellings the Contractor should be obliged, in order to avoid a public nuisance, to erect for his men closets connected with a sewer, where practicable, and to enforce their use. Within the limits of the watershed of a stream or reservoir whose water is used for drinking purposes, stringent regulation of sanitary matters is not infrequently necessary, which may involve much expense on the part of the Contractor.*

(*A*) Necessary conveniences, properly secluded from public observation, shall be constructed where needed for the use of laborers on the work, and the use of such conveniences shall be strictly enforced. Such conveniences shall be located, constructed and maintained subject to the approval of the Engineer, and the collections therein shall be removed at such times and to such places as he shall direct. The Contractor shall obey and enforce such sanitary regulations as may be prescribed by the Board of Health.

39. **Sale of Intoxicants.** — It is becoming increasingly common to prohibit the sale or use of intoxicants along the line of the work. There can be no doubt that the enforcement of such a provision operates to the advantage of everyone concerned.

(*A*) The Contractor shall neither permit nor suffer the introduction or use of spirituous liquors upon or about the works embraced in this contract or upon any grounds occupied by him.

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* The Catskill Aqueduct contracts may be cited as requiring a maximum of attention to these matters.

40. Discharge of Employees. — It is often necessary that the Engineer give directions to some employee of the Contractor. Situations have arisen in which the employee refused to follow such directions or persisted in attempting portions of the work which he could not properly execute, or made himself generally objectionable. To properly deal with such cases it is common practice to insert a clause giving the Engineer the right (which need seldom be exercised) to require the discharge of employees of the Contractor either for incompetence or for disorderly conduct.*

(*A*) If any person employed by the Contractor on the work shall appear to the Engineer to be incompetent or to act in a disorderly or improper manner, such person shall be removed from the work immediately on the requisition of the Engineer, and shall not be employed on the work again except on written consent of the Engineer.

(*B*) The Contractor shall employ only competent, skilful men to do the work, and whenever the Engineer shall notify the Contractor in writing that, in his opinion, any man on the work is incompetent, impertinent, disobedient, unfaithful, disorderly or otherwise unsatisfactory, such man shall be discharged from the work and shall not again be employed on it except with the consent of the Engineer.

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* The following clause is an extraordinary one, and should not be accepted as standard. (There are no italics in the original.)

" No disorderly or incompetent person shall be employed by the Contractor upon this work, and the Engineer shall have the right to require the dismissal of such person. *Should* the *Contractor use insulting* or *abusive language* or be guilty of improper conduct *to any employee* of the *Board* the General Superintendent shall have the right to *notify said Contractor* to *remain away from the work* or any part thereof, and *should* any *Contractor* guilty of such action *refuse* to comply with such notice then the General Superintendent will have the *right* to *close down all work* upon said contract until a *satisfactory apology* and assurance of proper action is given. . . . In the event of the exclusion of the Contractor from his work, he shall appoint a competent person or persons to represent him. Any *employee* of the *Board* who *uses abusive* or *insulting language* to the *Contractor*, when such action is shown to the General Superintendent, will be *removed from the work*."

41. Legal Restrictions. — A Contractor engaged on public work is likely to be subjected, by reason of national, state* or local statutes, to certain further restrictions regarding his relations to his employees, which would not affect him in his work for private individuals. Public work is generally more expensive than private work for this reason.

It is customary, and in some states required, to insert in all public work specifications or contracts not only a reference to the law, but a substantial quotation from its provisions, and to emphasize the importance of the Contractor's responsibility in the matter.

Labor laws cover in general the following three points (in addition to many other provisions having no relation to contract work):

(*a*) *Citizenship of employees*, — forbidding the employment (on public work) of convicts, of aliens, or of any workmen except such as are legal residents or perhaps voters of the state or town. A few states and many towns and cities have such a law or ordinance.

(*b*) *Hours of employment*, — restricting these to a certain maximum per day or week. Over half the states and the United States government have enacted laws covering this point.

(*c*) *Wages*, — not fixing a minimum wage, but in many states providing that the wages shall "not be less than the prevailing rate in the locality for similar services." The frequency of payment is in many cases stipulated, and some laws contain a prohibition against "store pay," and against the Contractor's dictating to his men concerning where they shall board or lodge.

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* The laws of the state in which the work is being done, not of the state in which the contract is signed. The student would do well to inform himself regarding labor laws affecting public work in his own state. Various publications of the United States Bureau of Labor give concise summaries of labor legislation throughout the country. Particularly valuable are the Twenty Second Annual Report and Bulletins Numbers 85, 91 and 97.

It has been stated that certain specifications for constructing a church edifice required of the workmen that they refrain from the use of profane or indecent language, as well as from the use of strong drink or tobacco, during working hours. The difficulty involved in securing such Utopian conditions would seem to consist chiefly in the enforcement of the prohibitions.

(*A*) (The following conformed, in 1911, to Massachusetts law in relation to public works contracts.)

The Contractor shall not request or require any laborer, workman or mechanic in his employ, or the employ of any subcontractor or other person doing or contracting to do the whole or a part of the work to be done in this Commonwealth, to work more than eight hours in any one calendar day; and shall give preference in employment, first, to citizens of Massachusetts, second, to other citizens of the United States; and shall allow all employees on said work to lodge, board and trade where they choose; and, unless otherwise authorized, in writing, by the Commissioner, shall pay all employees on any such work no less wages than is customary in said City in their several employments; and shall not obstruct any other person in doing work for the City. (Pipe Sewers and Drains Contract, City of Boston.)

(*B*) (The following conformed with California law in 1910.)

It is hereby stipulated that the said Party of the First Part shall forfeit, as a penalty, to the said City of , ten (10) dollars for each laborer, workman or mechanic employed in the execution of this contract by the said Party of the First Part or by any subcontractor under said Party of the First Part upon the work in this contract specified for each calendar day during which such laborer, workman or mechanic is required or permitted to labor more than eight hours in violation of the provisions of an Act of the Legislature of the State of California entitled "an act limiting the hours of service of laborers, workmen and mechanics employed upon the public works of or work done for the State of California or of or for any political subdivision thereof; imposing penalties for violation of the provisions of said act, and providing for the enforcement thereof," approved March 10, 1903, so far as the said act may be applicable to the said contract.

(*C*) (The following conformed to New York law in 1911.)

The Contractor shall comply with the provisions of the "Labor Law" as amended. No laborer, workman or mechanic in the employ of the Contractor, subcontractor or other person doing or contracting to do the whole or part of the work contemplated by the contract shall be permitted or required to work more than eight hours in any one calendar day, except in case of extraordinary emergency caused by fire, flood or danger to life or property. The wages to be paid for a legal day's work to all classes of such laborers, workmen or mechanics upon such work shall not be less than the prevailing rate for a day's work in the same trade or occupation in the locality where such work is being constructed. Each such laborer, workman or mechanic shall receive the prevailing rate of wages. This contract shall be void and of no effect unless the person or corporation making or performing the same shall comply with the provisions of Sections 3 and 14 of the Labor Law. . . . The Contractor shall punctually pay his employees who shall be engaged on the work covered by this contract, in cash and not in script, commonly known as store money, and he shall not, directly or indirectly, conduct or carry on what is commonly known as a company store if there shall at the time be any store selling supplies within two miles of the place where this contract is being executed. (Catskill Aqueduct contract, New York City, 1911.)

CHAPTER IX

GENERAL CLAUSES

The Contractor's Miscellaneous Responsibilities

In this Chapter are grouped, for convenience of discussion, a variety of General Clauses defining the Contractor's responsibility in matters of accidents to persons or property, unforeseen difficulties, local ordinances, patent rights, etc.

Despite the fact that the element of uncertainty in it is at times large,* contracting is not gambling. Specifications may be, and should be, so carefully drawn by the Engineer that this element of uncertainty is reduced to a minimum. There will still remain, however, a number of important risks which it is customary and right that the Contractor should assume. Many of these are more strictly responsibilities than risks, in that they can be provided for in advance. Some others are risks against which it is possible for the Contractor, if he so elects, to insure himself. The aim sought in this fixing of responsibility is that of making the Contractor what the law terms an "*independent contractor*," or one who is accountable for his own acts, rather than one who is simply an agent of the Owner.

42. Injury or Damage to Persons or Property.

(*a*) Property damage may be entailed simply by the execution of the contract; for this of course the Contractor could not equitably be held.

As illustrations of this form of damage may be cited the depreciation in value of a building plot as the direct result of a change in grade of the contiguous highway, or the effect of constructing a railroad very close to a handsome residence, or the flooding of lowlands above a bridge built with insufficient waterway.

(*b*) Injury or damage to persons or property may, however, be due to negligence or carelessness on the part of the Contractor (or his employees or agents). Injuries to persons* will be less likely to occur if the Contractor erects temporary guard railings, or displays warning signals or lights, etc. Similarly, damage to property can in most cases be prevented by proper care on the part of the Contractor. The injury or damage clause should be so worded, however, that it cannot be construed as prescribing to the Contractor just *how* he shall protect persons or property from danger, — it should simply state clearly and emphatically that the responsibility for accident due to the Contractor's carelessness or neglect or failure to warn of danger shall fall on his shoulders and not on the Owner's. Very delicate and complicated legal questions, such as the responsibility for the settlement of buildings adjoining deep excavations, etc., have frequently found their way to the courts in this connection.

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* Obviously, the risks involved in subsurface construction are relatively greater than those in connection with most open air structures.

That the laws of some of the ancients were severe and unrelenting in respect to damage resulting from defective construction would appear from the following extracts from the "Code of Khammurabi" (dating from about 2000 B.C.):

"If a builder build a house for a man and has not made his work strong, and the house has fallen in and killed the owner of the house, then that builder shall be put to death. If it kill the son of the owner of the house, the son of that builder shall they kill. If it kill the slave of the owner of the house, a slave equivalent to that slave to the owner of the house he shall give. If the property of the owner of the house it destroys, whatsoever it destroys he shall make good, and as regards the house he built and it fell, with his own property he shall rebuild the ruined house. If he build a house for a man and did not set his work and the walls topple over that builder from his own money shall make that wall strong."

These are of interest also in connection with the "sufficiency of the plans." (See Art. 30.)

(*A*) The Contractor shall erect and maintain barricades, red lanterns and danger signals, and shall be responsible for any and all accidents that may occur by reason of the work. The Contractor shall be responsible for any and all damage that may be done or caused to public or private property by reason of the prosecution of the work.

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* The word persons includes, of course, the Contractor's employees. Employers' liability laws, recently enacted in many states, affect the Contractor vitally at this point.

(*B*) During the performance of the work herein set forth the Contractor will place proper guards upon and around the same for the prevention of accidents, and at night will put up and keep suitable and sufficient lights, and he will indemnify and save harmless ...... (the Owner) .... against and from all suits and actions of every name and description, brought against them, and all costs and damages to which .... (the Owner) .... may be put on account or by reason of any injury or alleged injury to the person or property of another, resulting from negligence or carelessness in the performance of the work, or in guarding the same, or from any improper materials used in its prosecution, or by or on account of any act or omission of the Contractor or his agents, and that the whole or so much of the moneys due to the Contractor under or by virtue of this contract as shall be or may be considered necessary by .... (the Owner) .... shall and may be retained by........ (him) .... until all such suits and claims for damages as aforesaid shall have been settled and evidence to that effect furnished to the satisfaction of ...... (the Owner) .....

(*C*) The Contractor shall put up and maintain such barriers and red lights as will effectually prevent any accident in consequence of his work, for which .... (the Owner) .... might be liable, and the Contractor shall be liable for all damages occasioned in any way by his own acts or neglect or that of his agents, employees or workmen.

43. Unforeseen Difficulties.

(*a*) This phrase may, according to the nature of the work, include an almost interminable number and variety of fortuitous occurrences likely to add to the cost of the work to the Contractor, and perhaps to delay him as well. (See Art. 52.) The rock may prove tougher to excavate than he had anticipated, the sand foundation less firm, labor more difficult to obtain or less efficient, material more expensive, the river higher than usual at the season, etc.

(*b*) It is common to provide a sort of blanket clause covering "unforeseen difficulties, obstructions or encumbrances" in general, and, without specifically naming any, to throw the responsibility for meeting them, one and all, on the Contractor. He would naturally provide something in his original bid to cover these difficulties. Sometimes damage from the ever-troublesome elements is mentioned separately because of the fact that in some contracts the chance of loss from fire or flood, wind or lightning constitutes the chief risk and can ordinarily be insured against.*

The Contractor probably could not, even under such a clause, be required to make good the damage caused by "Acts of God" — such as the Johnstown Flood, the San Francisco Earthquake, and similar almost unprecedented catastrophes — or "Acts of the Public Enemy," meaning the ravages of an invading army.

A typical case may be cited, in which a bridge Contractor sought to recover from a City damages for the delay occasioned by the presence of a large iron water pipe crossing a stream at a point where the Contractor had to sink a crib for the bridge he was building under contract with the City. The Contractor had no right to remove the pipe, as it was there by permission of the City. The claim set up by the City was that the pipe was one of the unforeseen obstructions, concerning which the Contractor took his chances. The court held, however, that the obstruction was legalized by the City to a certain extent, and that it could not, therefore, be removed by the Contractor, without his making himself liable for trespass. The court held, further, that the proper course for the City to pursue in such case, after it had been notified by the Contractor of the difficulty, would have been either to revoke the water company's license, or to make some arrangement so that the Contractor could proceed. The court, therefore, decided that the City was liable for the damages to the Contractor resulting from the delay, after he had notified the City of the obstruction.

A rip-rapped embankment intended to serve as an approach to a bridge across a creek is nearly completed. The bottom seems stable, and the work is progressing to the satisfaction of everyone. Suddenly a large part of the embankment settles out of place, and has to be rebuilt. Shall such an accident be considered an unforeseen difficulty or shall the Contractor be compensated?

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* In many building contracts the Owner assumes a part or all of the fire risk.

(*A*) All loss or damages arising out of the nature of the work to be done under the contract, or from any unforeseen obstructions or difficulties which may be encountered in the prosecution of the same, or from the action of the elements, or from incumbrances on the line of the work, shall be sustained by the Contractor.

(*B*) The Contractor shall protect his work and materials from damage due to the nature of the work, the action of the elements, the carelessness of other Contractors, or from any cause whatever, until the completion and acceptance of the work. Should any damage occur, he shall repair it at his own expense, and leave the work to the satisfaction of......(the Owner)...... in every particular.

44. Local Ordinances, Permits, Licenses, etc. — The responsibility of compliance with all laws or ordinances affecting the work of construction is usually and properly placed on the Contractor. In addition to this, if it is thought desirable, he should be required to secure such permits (as for street openings), licenses, etc., as may be necessary. On all of these points it would be entirely possible for the Contractor to inform himself before signing the contract, so that the only risk he would take would be concerning any laws which might be enacted while the work was in progress.

The student may mention any laws or ordinances which would be likely to affect a Contractor engaged in dredging a navigable river, in excavating rock, in the erection of a city building, in paving a street.

(*A*) In all the operations connected with the work herein specified all State laws and local by-laws or ordinances controlling or limiting in any way the actions of those engaged in the work, or affecting the method of doing the work or materials applied to it, must be respected and strictly complied with.

(*B*) The Contractor shall keep himself fully informed of all existing and future local ordinances and regulations, state and national laws in any manner affecting the work herein specified, and he shall at all times observe and comply with and shall cause all his agents and employees to observe and comply with said ordinances, laws and regulations, and shall protect and indemnify .... (the Owner) .... and .... (his) .... officers and agents against any claim or liability arising from or based on the violation of any such laws, ordinances, regulations, etc.

45. **Patent Rights.**— These may cover materials, appliances, or processes used in construction.* (The student should cite an illustration of each.) The clause should be so worded as to make it clear that the Contractor is:

(*a*) To pay all fees or royalties.

(*b*) To defend any suits which may be brought for infringement.

(*A*) The Contractor agrees to indemnify and save harmless .... (the Owner) .... against all loss or damage, claims and demands, cost and charges that may arise or accrue by reason of the infringement of any patent or the violation of the rights of any person under letters patent in the performance of this contract, or by reason of the manner in which the same is performed, or through the use of any patented article or device.

(*B*) The Contractor stipulates, covenants and agrees for himself, his heirs, executors, administrators, suc-

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* For comments on the advisability of specifying patented articles see Art. 64. An idea of the increasing number of patents affecting a single department of civil engineering may be obtained by referring to such a list as that published in *Municipal Engineering*, vol. 41, p. 410; vol. 42, p. 68, and vol. 43, p. 127; or in the Good Roads Year Book for 1912.

> cessors and assigns, that he has the right, power, authority and license to furnish all materials and do all the work in said specifications as hereinbefore described, and that he and his heirs, executors and administrators, successors and assigns will, at his and their own cost and charge, defend any and all actions and proceedings that may be brought against .... (the Owner) .... for infringement of patent rights, by reason of the use of any such materials or articles furnished, or work done as aforesaid: and that he and they will indemnify and save harmless .... (the Owner) .... from any judgment that may be recovered against them or either of them for infringement of patents or patent rights by reason of the use of said articles or materials for the doing of said work as aforesaid.

46. Establishment and Preservation of Survey Points. — This is a clause of convenience only, requiring:

(*a*) That the Contractor shall furnish labor or material necessary to the establishing of certain survey points. This provision is not of course necessary in many specifications.

(*b*) That the Contractor shall take all precautions to preserve points given him by the Engineer. A specific forfeit of a sum of money for each point unnecessarily disturbed is at least an incentive to care on the part of the Contractor's employees.

> (*A*) All lines and grades will be given by the Engineer, but the Contractor shall provide such material and give such assistance therefor as may be required by the Engineer, and the marks so given shall be carefully preserved.
>
> (*B*) The Contractor shall furnish, free of charge, all stakes and such temporary structures as may be necessary for marking and maintaining points and lines given by the Engineer for the building of the work, and shall give said Engineer such facilities and materials for

marking said lines and points as he may require, and the Engineer's marks must be carefully preserved.

47. **Public Travel.** — This is another of the clauses mentioned in Art. 9 which might be considered as not belonging strictly to the group called "general." Under this head it should be made clear, for example, as to whether or not the Contractor will be allowed to exclude the public entirely from the work (which he would generally prefer to do on account of the saving in expense and annoyance), or, if otherwise, how much, if any, of the work at a time may be closed to public travel. All classes of traffic must in some instances be considered, persons traveling on foot, and persons or freight being transported in conveyances, by land or water.

(*A*) Public travel shall not be needlessly inconvenienced, nor shall it be wholly obstructed at any point without the written consent of the Engineer, in which case the Contractor shall place plain and properly worded signs at the nearest cross streets or wherever the public can pass around the obstruction by the shortest and easiest route.

(*B*) The Contractor shall make suitable and adequate provision, satisfactory to the Engineer, for the safe and free passage of persons and vehicles by, over or under the work while it is in progress.

CHAPTER X

GENERAL CLAUSES

Progress of Work

The group of General Clauses that, directly or indirectly, touch on the progress of the work are included in this Chapter. Among these are a clause fixing important dates, one prohibiting work at certain times, one outlining the procedure in case the Contractor abandons operations, one giving the Owner the right to order the work temporarily discontinued, and two clauses covering delays and the consequential damages.

48. Certain Fixed Dates.

(*a*) It is generally advisable that a time be fixed for beginning work under a contract, in order that the Contractor may not delay in starting until it is too late to do the work satisfactorily. A reasonable interval, varying with the magnitude of the work (seldom less than a week or more than a month), in which to collect his equipment, materials and working force, should be allowed him after the contract is signed.

(*b*) Fixing a limit to the time allowed for completing a contract is essential, else the work may drag on indefinitely. Some contracts mention a period of time (as a certain number of days), within which the work is to be finished. The word "days" used in this connection has been held to mean "working days," and is somewhat indefinite. A more precise term is "calendar" days. The mention of a definite date for completion is doubtless more precise still, and admits of no argument.

(*c*) On very large and important pieces of construction work, especially where a number of sections are being completed under separate contracts, a schedule of progress is not infrequently outlined in the specifications, furnishing a standard by which to define normal progress.

The student may criticize the following clause:

"The Contractor shall commence and prosecute the work at such points, at such times and with such forces as the Engineer may direct."

(*A*) The work shall be begun within ten (10) days from the date of the signing of the contract, and shall be completed within sixty (60) days from said date.

(*B*) The Contractor shall begin work not later than July 1st, 1913, and shall complete the entire work not later than Dec. 1st, 1913.

(*C*) The Contractor shall commence the work of this contract on the ground within thirty days from the date of award of this contract. The whole work shall be completed and ready for use on or before Oct. 15th, 1914.

(*D*) The Contractor shall commence the construction of the work to be done under this contract at four (4) different places on ten (10) days written notice from the Engineer, and shall complete the same within the time specified in his proposal, it being expressly understood and agreed that the time of beginning, rate of progress and time of completion of the work are essential conditions under this contract.

49. Work Prohibited When.

(*a*) Almost all specifications forbid the Contractor requiring his men to work on Sundays or legal holidays, although the prohibition is properly so qualified as not to apply in cases of danger to property, health or life.*

(*b*) Night work of certain kinds (hydraulic dredging, pumping or riveting, for example) may be objectionable to near-by residents. Certain kinds of work cannot be well done or satisfactorily inspected by artificial light.

(*c*) Some work cannot be properly done under extreme weather conditions.

The student may mention work which cannot be successfully prosecuted during intense cold weather; during moist weather; during very dry weather.

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* Laws in many states cover this point.

(*d*) The specifications should plainly state, for the Contractor's benefit, just when he will ***not*** be permitted to work.

(*A*) No work shall be done between the hours of 6 P.M. and 7 A.M., nor on Sunday, except such as is necessary for the proper care and protection of work already performed or except in case of an emergency and then only with the permission of the Engineer.

(*B*) No night or Sunday work requiring the presence of an Engineer or inspector will be permitted, except in case of emergency, and then only to such extent as is absolutely necessary, and with the written permission of the Engineer, provided that this clause does not operate in case of a gang organized for regular and continuous night work. In case any work is performed at night the Contractor shall provide sufficient artificial light, in the judgment of the Engineer, to properly prosecute the work. No Sunday work will be permitted except in case of emergency and then only with the consent of the Engineer and to such an extent as he may judge to be necessary.

(*C*) In case any work is to be done at night the Contractor shall give notice to the Engineer at least two days before such work is started. Only such classes of work shall be done at night as can be properly inspected, and adequate light and facilities for inspection shall be supplied. . . . No concrete shall be placed or other work done which is subject to damage by frost during the winter months, between December first and April first.

50. Abandonment.

(*a*) A Contractor may, before his contract is completed:

(*i*) Actually remove all of his laborers, materials and tools with the deliberate purpose of giving up the contract. The common law would recognize this alone as constituting abandonment, construing it as a breach of contract on the part of the Contractor.

(*ii*) Withdraw most of his men, leaving the work in such shape that any real progress is impossible.

(*iii*) Willfully and persistently disregard the explicit directions of the Engineer and attempt to construct the work without regard to the plans or specifications.

(*b*) Under any of the above circumstances it is or may be considered that he has "abandoned" the work, and specifications should provide for dealing with the situation (after reasonable notice to the Contractor) in either of two ways:

(*i*) The contract may be declared null and void, the Contractor paid what money, if any, is due him, and formally discharged. This leaves the Owner free to consult his own pleasure in respect to completing the work. (See Art. 1.)

(*ii*) The contract may be allowed to remain in force while the Owner employs other persons to complete the work either by contract or day's work. If this costs less than the balance due on the original contract, the difference is paid *to* the Contractor, otherwise *by* him or by his bondsmen.

(*A*) Should the Contractor neglect or abandon the work, or if at any time the Engineer be convinced that the work is unreasonably delayed, or that the conditions of the contract are being willfully violated, or executed carelessly or in bad faith, he may notify the Contractor in writing, and if his notification be without effect within twenty-four hours after the delivery thereof, then and in that case the Contractor shall discontinue all work under the contract, and the Engineer shall have full authority and power to immediately purchase and hire materials, tools, labor and machinery for the completion of the contract at the expense of the Contractor or his sureties or both; or the said contract may be declared null and void, and the security bond and the retained percentage and the materials built into the work and the materials delivered shall then become the property of .... (the Owner).

(*B*) If the work under this contract shall be abandoned, or if at any time the Engineer shall be of the opinion, and shall so certify in writing to .... (the Owner) .... that the said work is unnecessarily or unreasonably delayed, or that the Contractor is willfully violating any of the conditions or agreements of this contract, or is not executing said contract in good faith, or fails to show such progress in the execution of the work as will give reasonable grounds for anticipating its completion within the required time, ... (the Owner) .... shall have the power to notify the said Contractor in writing to discontinue all work, or any part thereof, under this contract; and thereupon the said Contractor shall immediately cease to continue said work or such part thereof as .... (the Owner) .... shall designate, and .... (the Owner) .... shall thereupon have the right, at .... (his) .... discretion, to contract with other parties for the delivery of any material or completion of any part or all of the work left uncompleted by said Contractor, or for the correction of the whole or any part of said work; and in case the expense so incurred by said .... (Owner) .... is less than the sum which is or which would have been payable under this contract if the same had been completed by the said Contractor, then the said Contractor shall be entitled to receive the difference; and in case such expense shall exceed the last said sum, then the Contractor shall, on demand, pay the amount of such excess to the said .... (Owner) ......; but such expense to be paid by the Contractor shall not exceed the amount of security for the performance of this contract.

51. Right to Suspend.

(*a*) During the progress of the work contingencies may arise making it necessary that the Owner ask the Contractor to suspend operations for a longer or shorter period. In the early days of railroad building it was not uncommon for the railroad companies to award construction contracts before they had secured all the necessary right of way. Unexpected difficulties (financial and otherwise) not having any direct connection with the Contractor's work sometimes require that the Owner stop the work for a time.

(*b*) To provide for contingencies of this sort there has been introduced into some specifications a clause giving the Owner the right to shut down or suspend the work at will. That the exercise of such a right might work a gross injustice to the Contractor is readily seen. A complete shut-down necessitates the proper storage or protection of the plant, the discharge of an organized body of workmen and the enforced idleness of capital. In justice to the Contractor such clauses should (and sometimes do) contain provision for reimbursing him in some way for such losses as an enforced suspension of the work in question must entail.

The student should clearly discriminate between giving the Owner the right to suspend work for the various reasons above mentioned and the right given in Art. 50, (*b*).

Criticize the following, from paving specifications:

"The Highway Commissioner shall have the right to suspend the work at any time whenever in his judgment it becomes necessary."

> (*A*) (The Owner) .... reserves the right of suspending the whole or any part of the work to be done hereunder, at any time, if ...... (he) .... shall deem it for .... (his) .... interest to do so. If the work is so suspended, the Contractor shall be entitled to an extension of the time for completing the work equal to the time during which the work shall have been suspended by the order of .... (the Owner) ...., and .... (the Owner) .... shall pay to the Contractor the actual cost (including a reasonable rental for space occupied), to be ascertained and

certified monthly by the Engineer, of storing and protecting any part or parts of the plant which shall have been shipped from the place of manufacture or which shall be ready for shipment, together with interest at the rate of five (5) per cent per annum for the period during which the work shall be suspended on the twenty (20) per cent reserved from the monthly estimates made previous to the date when work is ordered suspended.

52. Extension of Time.

(*a*) Certain delays, impossible to foresee, occur in connection with almost all construction projects. The most frequently recurring result from the action of the elements, weather conditions, labor troubles, failure to secure material promptly and the like. For some of these causes it would be only fair to grant an extension of time (see Art. 43), but it is not always easy to state just which of these will and which will not be considered legitimate causes for delay. Delays caused directly by the Owner, whether or not they involve actual suspension, are of course beyond the Contractor's power to prevent. The death of the Contractor has been held not to be legitimate cause for delay. A very few specifications, notably those used in the construction of portions of New York City's Catskill Aqueduct, contain a definite statement that an extension of time will not be allowed for any cause whatever.

(*b*) There are four points to be made clear in such a clause, namely:

(*i*) Enumerate as far as possible any future occurrences for which it is to be understood that the Owner will or will not be willing to grant an extension of time.

(*ii*) State that an extension of time shall not be construed as weakening the original contract in any particular. It might otherwise be held by the bondsmen (see Arts. 11, 29) that they were no longer obligated. Stated in legal terms, the expression would be that any delay granted by the Owner should not operate as a "waiver of his rights" to insist on the performance of the contract, in spite of the fact that he had, in substance, permitted the Contractor to break it.

(*iii*) Provide that the Contractor shall give formal notice, at the time it occurs, of any such delay, with full particulars as to cause and duration.

(*iv*) Stipulate that no additional compensation will be allowed the Contractor for any losses occasioned him by the delays, except in cases of actual suspension. (See illustrations under next clause.)

(*A*) "Should the Contractor be delayed in the prosecution of the work by the act, neglect or default of the Owner, of the Architects, or of any other Contractor employed by the Owner upon the work, or by any damage caused by fire or other casualty for which the Contractor is not responsible, or by the combined action of workmen in no wise caused by or resulting from default or collusion on the part of the Contractor, then the time herein fixed for the completion of the work shall be extended for a period equivalent to the time lost by reason of any or all of the causes aforesaid, which extended period shall be determined and fixed by the Architect: but no such allowance of time shall be made unless a claim therefor is presented in writing to the Architect within forty-eight hours of the occurrence of the delay." From standard building contract of the American Institute of Architects.

(*B*) If the Contractor is obstructed or delayed in the prosecution or completion of the work by reason of the neglect, delay or default of any other Contractor having a contract with ...... (the Owner) ...... for adjoining or contiguous work, or by reason of any damage that may happen thereto by the unusual action of the elements, or by reason of the abandonment of the work by the employees in a general strike, or by reason of any delay on the part of .... (the Owner) .... in doing the work or furnishing the material to be done and furnished by ...... (the Owner) ...., the Contractor shall have no claim for damages for any such cause or delay, but he shall be entitled to such extension of the time herein specified for the completion of the work as the Engineer shall determine to be just and proper, provided however that such claim for such extension of time is made by the Contractor in writing to the Engineer within one week from the time when any such cause for delay occurs.

(*C*) The Contractor shall not be entitled to any claims for damages from any hindrance or delay, from any cause whatever, in the progress of the work, or any portion thereof, but when such hindrance or delay results from causes entirely beyond the control of the Contractor, said hindrance or delay, excepting such as may from time to time result from ordinary and not unusual weather conditions for the season of the year when he is at work, may entitle the Contractor to such an extension of time for completing the contract as may be determined by the Engineer, provided the Contractor shall have given notice in writing of the cause of the detention.

53. **Failure to Complete Punctually.** — The student should realize that to compel a Contractor (or in fact either party to a contract of any description) to fulfil the terms of his contract is well-nigh impossible.* There are, therefore, no means by which either Owner or Engineer can actually force a Contractor, even under a strong and carefully worded contract, to complete a piece of work within the agreed time.

(*a*) As an illustration, suppose that a contract provided for the erection of a small bridge of simple construction, and that the time limit for completion named in the specifications (or contract) was six months.† If the Contractor had not finished the bridge at the end of the six months — whether or not he did so at a later date — he would not have carried out the terms of his contract. In such event the Owner might have a case against him for "breach of contract," and could, if he thought it advisable, take the matter to the courts and sue the Contractor for damages. Under these circumstances it is probable that the courts would hold that the Contractor must make good any money loss which the Owner could prove he had suffered by the Contractor's failure to complete the bridge according to the terms of the contract.

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* Only in rare instances can "specific performance" be enforced.

† Had no time limit been mentioned the courts would hold that the Contractor was bound to complete within a "reasonable" time.

(*b*) But suppose instead that the Owner, realizing the futility of attempting to compel the Contractor to live up to the terms of his contract, yet not wishing to be under the necessity of appealing to the courts, had provided in the contract (or specifications) that the Contractor should, in the event of his not finishing on time, forfeit, as a penalty, either a large single sum of money or a sum which increased with each day's delay. In case the Contractor failed to complete on time the Owner might now attempt to collect the sum provided for. The Contractor would perhaps object to making the payment and the case would go to the courts as before. Decisions in many similar cases have been that since forfeiture of the money was held over the Contractor's head as a form of penalty (or punishment) and since they (the courts) alone had the right to inflict punishment, the money could not be collected. The courts will allow a person suffering from a breach of contract to collect only such reasonable money damages as he can show he has suffered.*

Courts are, moreover, jealous of their rights, and are apt to discourage any attempt to settle damages before they have accrued.

(*c*) To avoid the annoyance of an appeal to the courts the following expedient is now commonly adopted. A reasonable sum (generally per diem) is mentioned in the specifications as "agreed and liquidated damages" which the Owner will suffer by reason of the failure to finish on time, and "not by way of penalty." Sometimes it is added for emphasis that "time is of the essence of the contract." This generally discourages the Contractor from going to law, and will be upheld in the courts, if it can be plainly shown that the amount named was reasonable and was arrived at as the result of an attempt made in good faith to estimate beforehand the actual damage that such a delay would involve.

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* One exception to this ruling is in the case of breach of promise to marry — in which event injured feelings or reputation may sometimes be converted into cash.

(*d*) It is not at all necessary that a reciprocal relation (penalty and bonus) be established. The bonus has a place in civil engineering specifications, and is but rarely found outside of contracts for pumping engines, etc.

The contract price for a piece of work was $2700. The Contractor finished it much later than he agreed to, and the Owner's damages, based on a per diem forfeit provided in the contract, amounted to $2100, leaving the Contractor $600 for his work. The case was taken to the courts for adjustment.

A general Contractor entered into an agreement with the United States Government to build a structure in Pennsylvania, which he was to complete within seven months. The contract provided that the Contractor should pay the Government $10 for each day that the work remained unfinished beyond the seven months. The contract also contained the following clause: "Unavoidable delays are such as result from causes which are undoubtedly or may reasonably be presumed to be beyond the control of the Contractor, such as acts of Providence, unusual storms, fires (not the result of negligence), fortuitous events, inevitable accidents, etc. Delays caused by the Acts of the Government will also be regarded as unavoidable delays." The contract contained other provisions outlined under Art. 52. The Contractor did not finish on time, as he was unable to get his structural steel promptly. He refused to pay the $10 per day, arguing that the delay in receiving the material was one of the "unavoidable delays." The court decided that the delay was not unavoidable but was due to poor judgment on the Contractor's part. It should be added that the decision was doubtless influenced by the Contractor's having neglected to give more than a verbal notice of the delay at the time it occurred.

The contract for furnishing the cables of the Williamsburg Bridge (New York City) contained the following clause: "And the said party of the second part (the Contractor) hereby further agrees that the said parties of the first part (the Bridge Commissioners) shall be and they are hereby authorized to deduct and retain out of all the moneys which may be due or become due to the said party of the second part under this agreement, as liquidated damages for the non-completion of the work aforesaid within the time herein specified for its completion, or within the stipulated time to which the same may be extended in writing by said Commissioners, as herein provided, and not by way of penalty, the sum of $1000, for each and every working day the time consumed in the execution of the work may exceed the time stipulated for its completion, or such stipulated time to which the same may be extended by said Commissioners as aforesaid, which sum of $1000 per day, in view of the difficulty of estimating such damages, is hereby agreed upon, fixed and determined by the parties hereto as the liquidated damages that the said city will suffer by reason of said default, and not by way of penalty." The cables not having been furnished on time, the Commissioners retained the liquidated damages of $1000 per day. The Contractor for the cables sued to collect the amount and won his case, as it was brought out in the trial that the bridge could not have been used sooner even though the cables had been complete, and that therefore the city suffered little if any damage by reason of the delay.

The student may mention the money damage which might result to the Owner from delay on the part of the Contractor in completing a railroad bridge; a power station; a highway.

The student may criticize the following clause from paving specifications: "If the contract work shall not be fully completed according to the terms of this specification within the time herein limited for its performance, unless further time for completion be granted to the Contractor by the Board of Street Commissioners, the Contractor shall forfeit and pay for each day which may elapse after the time so limited, and before its final and full completion, the sum of twenty dollars per day."

(*A*) The sum of twenty dollars ($20) per day for each day that any work shall remain uncompleted after the time specified in the contract for its completion shall be deducted from the amounts due said Contractor, not as a penalty but as just and liquidated damages.

(*B*) In case the Contractor shall fail to complete the work hereinunder in accordance with the specifications and to the satisfaction of .... (the Owner) .... and the Engineer within the time aforesaid the Contractor shall and will pay to .... (the Owner) .... the sum of ten dollars ($10) for each and every day the time consumed in said performance and completion may exceed the time hereinbefore allowed for the purpose, which sum, in view of the difficulty of ascertaining the loss which ...... (the Owner) .... will suffer by reason of the delay in the performance of the work hereunder, is hereby agreed upon, fixed and determined by the parties hereto as the liquidated damages that .... (the Owner) .... will suffer by reason of said delay and default and not as a penalty; and .... (the Owner) .... shall and may deduct and retain the amount of such liquidated damages out of the moneys which may be due or become due to the Contractor under this agreement.

(*C*) The parties mutually agree that time is of the essence of this contract and that the damages to ...... (the Owner) .... for failure of the Contractor to have fully completed the work on or before the date last mentioned shall be .... dollars per day for each day after the said date that shall elapse before the work shall be fully completed, which amount shall in no event be considered as a penalty, or otherwise than the liquidated and adjusted damages of .... (the Owner) .... because of said delay and which damages the Contractor shall promptly pay, and which damages the Engineer may retain from any moneys which otherwise shall be payable to the Contractor; and in the event that the moneys payable as aforesaid are not sufficient to fully compensate ...... (the Owner) .... because of such delay, then the Contractor promises and agrees to pay the balance of said damages to ...... (the Owner) ...... promptly upon demand by the Engineer.

CHAPTER XI

GENERAL CLAUSES

Terms of Payment

In the form of contract given in Chapter II, the Owner agrees to pay the Contractor a sum of money for his work. In most contracts this simple statement needs elaboration. Such is the purpose of the following General Clauses, which treat of funds available, of subletting, of extra work, of partial payments and of final payments. Engineers certificates, on which payments are based, are parenthetically explained and illustrated. The Chapter closes with a brief consideration of maintenance clauses or guarantees.

54. **Source and Nature of Funds Available.** — A government contract is sometimes let before funds to complete the entire project are on hand, future appropriations being dependent on acts of Congress or of a state legislature. Municipal contracts may be entered into before the bonds have been sold or assessments collected with which to provide the necessary money. In such cases a complete statement of the source from which the Contractor's payment is to be derived should be plainly made in the specifications so that he may be warned in advance in case of a possibility of delay in receiving his money. Occasionally a municipality expects the Contractor to take part of his money in assessment bills (which he is to collect) or in bonds,* in which cases it should be plainly so provided in the specifications.

(*A*) This contract is founded on an appropriation of .... It is mutually understood that in no event shall the City or any officer, agent or employee thereof be liable for any work herein founded in excess of the expenditures authorized thereby.

(*B*) And it is understood and agreed that payments under this agreement shall be made only out of the collections from the assessments to be imposed or assessed against the abutting owners on both sides of the parts of the respective streets to be paved to defray one-fourth of the expense of such work and three-fourths from the issue of bonds of said Village pursuant to the provisions of Chapter ...... of the Laws of 19.. and the resolutions of the Board anything in this contract to the contrary notwithstanding.

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* Such a practice is not to be commended.

(*C*) Unless otherwise stated in the contract the Contractor shall accept as part payment of the amount of his contract the assessment bills charged upon the properties in front of which the sewer shall be completed as per ordinance approved ...., 18.., and supplemented by ordinance approved ...., 18.. He shall collect them at his own cost, and the better to enable him to do so, he may use the name of the City of ...., and employ all legal remedies or proceedings, whether of lien or otherwise, to which the City may be competent.

55. **Subletting and Assignment.*** — If a Contractor sublets all or a part of his contract to others the Owner may still hold him and not recognize the subcontractors. It is sometimes eminently desirable, and even understood beforehand by all concerned, that portions of a large undertaking shall be sublet to various specialists. On the other hand, a subcontractor may be thoroughly dishonest, incompetent or lacking in just the experience and skill necessary for the successful completion of the work in question; or a contract may be successively sublet until the subcontractor who actually does the work undertakes it at such a low figure that he cannot do it well and make a profit. Some Engineers hold that subletting of public work should not be permitted.

Some contracts cannot be assigned — a contract to marry, for example, or one for professional services. In many States certain forms of assignment are forbidden by law. The question of assignment of moneys or of subletting of work is a large and complicated one. Legal decisions on these points have been conflicting, and in many cases the courts have treated a clause prohibiting subletting as having no weight.

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* The student may distinguish between the terms.

This clause should provide simply that the Contractor shall not sublet any portion of the contract without the express permission of the Owner.

(*A*) The Contractor shall not assign or sublet any portion of this contract without the consent of ...... (the Owner) ....

(*B*) The Contractor agrees not to assign, transfer, convey, sublet or otherwise dispose of this contract, or his right, title or interest therein or his power to execute the same, to any person, company or corporation without the previous written consent of .... (the Owner) ....

(*C*) The Contractor shall give his personal attention constantly to the faithful prosecution of the work, shall keep the same under his personal control, and shall not assign, by power of attorney or otherwise, or sublet the work or any part thereof without the previous written consent of .... (the Owner) .... He shall state to the Engineer, in writing, the name of any subcontractor he intends to employ, the portion of the work which he is to do or the material which he is to furnish, his place of business and such other information as .... (the Owner) .... may require, in order to know whether such subcontractor is reputable and reliable, and able to perform the work or to furnish the material as called for in these specifications. He shall not, either legally or equitably, assign any of the moneys payable under this agreement, or his claim thereto, unless by and with the like consent of .... (the Owner) ....

56. Extra Work.

(*a*) During construction it may be necessary or expedient for the Owner to require of the Contractor a greater outlay, for labor or materials or both, than was originally contemplated by anyone concerned. Under a unit price contract, if the change involves simply an additional amount of work for which a unit price has already been fixed, the adjustment is simple. This was pointed out as one of the advantages of unit prices. (See Art. 20.) Under any form of contract it is possible to make payments not originally provided for in either of two ways:

(*i*) An additional or "supplemental" contract may be entered into between Contractor and Owner, covering the additional work. Where this does not involve legal difficulties it may prove the better method, especially if important changes in the design are involved. Such a procedure in connection with public work is open to the objection that the supplemental contract is entered into without competition. On private work supplemental contracts may of course be used without inviting criticism.

A contract provided for grading a residence park, laying water, gas and sewer pipes, etc. While the work was in progress it was decided to put down concrete walks. These were provided for by a supplemental contract with the Contractor who was doing the rest of the work.

(*ii*) Practically all specifications contain a clause providing for the performance, under the original contract, of what is technically called "extra work." Necessity for extra work may arise from deliberate change in design, from totally unlooked for conditions, or from other causes.*

(*b*) It is sometimes argued that under a perfectly drawn contract there will be no extra work. Young engineers, thinking they have provided for every possible contingency, have drawn up specifications in which the clause was intentionally omitted.

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* Extra work originating from errors in laying out the work is of comparatively rare occurrence. A costly instance may be cited in which a tunnel, being constructed for a certain municipality, was incorrectly staked out by the City Engineer. The rectification of this error involved the filling of the cavity with masonry to the extent of over eight thousand cubic yards, all of which was done by the Contractor as extra work.

This is bad practice. Specifications which distinctly state that there shall be no extra work are positively unfair. In spite of this fact it is in some localities forbidden by law to make any allowance for extras on public contracts. Such a stand is of course directed against the evils of contracts in which the larger part of the profit is expected to be derived from extravagant extras.

The following comment on the evils of extra work was written by a Roman architect * and Engineer about the year 25 B.C.

"In the magnificent and spacious Grecian city of Ephesus an ancient law was made by the ancestors of the inhabitants, hard indeed in its nature but nevertheless equitable. When an architect was intrusted with the execution of a public work, an estimate thereof being lodged in the hands of a magistrate, his property was held, as security, until the work was finished. If, when finished, the work did not exceed the estimate, he was complimented with decrees and honors. So when the excess did not amount to more than a fourth part of the original estimate, it was defrayed by the public, and no punishment was inflicted. But when more than one-fourth of the estimate was exceeded, he was required to pay the excess out of his own pocket. Would to goodness that such a law existed among the Roman people, not only in respect of their public but also of their private buildings, for then the unskillful could not commit their depredations with impunity, and those who were the most skillful in the intricacies of the art would follow the profession. Owners would not be led into an extravagant expenditure so as to cause ruin; architects themselves, from the dread of punishment, would be more careful in their calculations, and the Owner would complete his building for that sum, or a little more, which he could afford to expend ...." From "The Architecture of Marcus Vitruvius Pollio" (commonly called Vitruvius), Introduction to Book 10.

(*c*) It is not possible at all times to draw a sharp line between work that is properly a part of the contract and work that is not. The making of such distinctions often falls into the category of the Engineer's judicial duties. (See Arts. 25, 33.)

(*d*) A number of important points need to be included in the specification clause covering extra work:

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* Roman architects engaged in the practice of much that we now class as civil engineering.

(*i*) That it shall be ordered in writing,* either by the Owner through the Engineer or by the Engineer with the authority of the Owner.

Let it be remembered that the Engineer should not, under ordinary circumstances, assume this responsibility, as he is not a party to the contract. Except in very unimportant and inexpensive details the letter of this stipulation should be strictly observed.

(*ii*) That it shall be paid for at cost-plus-a-percentage, the cost to be determined by the Engineer.

The question immediately arises as to what to include in the cost, whether or not certain fixed charges, as rent, interest, supervision, properly belong in it. The percentage named is seldom less than 10 per cent or greater than 15 per cent, and represents what may be considered the Contractor's profit. In contracts where the labor item is relatively large, where the risk is great or where the work can be successfully prosecuted during only a part of the year it is reasonable to assume that the profits should be larger than under other circumstances. (See Art. 57.)

(*iii*) That the Contractor must furnish such information, as time books, bills for materials or freight, as will enable the Engineer to arrive at a correct estimate of the cost.

In addition to this, if possible, some person under the Engineer's direction (as the inspector or the resident Engineer) often keeps an account by which to check the Contractor's figures.

(*iv*) That the Contractor shall make all extra work claims periodically — monthly, for instance. This ensures that the several matters shall be settled while still fresh in the minds of those concerned, and the provision should be more generally made.*

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* According to many court decisions similar to the following, neglect on the part of the Engineer to put the instructions in writing would not prevent the Contractor from collecting payment. The plan of written orders should be followed, however, as tending to caution on the part of all concerned.

"Where a contractor, with the knowledge and consent of the owner, and under direction of the architect, but without a written order, performs extra work entailing additional expense, he will not be precluded from recovering reasonable compensation therefor by a clause in the contract which provides that no alteration shall be made in the work done or described by the drawings or specifications, except upon a written order from the architect." (121 N. W. Rep. 957.)

The right to have any extra work performed by another person (in case the Contractor refuses to do it) is in some specifications reserved. The value of such a provision seems problematical.

Further than this, some Engineers prefer to state in the specifications that extra work shall be under the Engineer's direction to just the extent that the regular work is; and some specifications state that extra work may entitle the Contractor to an extension of time.

(*A*) The Contractor shall do any and all extra work necessary for the proper construction or completion of the whole work herein contemplated as may be ordered in writing by .... (the Owner) ...., and as full compensation for such work the Contractor shall accept an amount equal to the actual cost of the said extra work as estimated by the Engineer, plus fifteen (15) per cent profit. In estimating the cost of extra work no allowance will be made for the use of tools or plant or for general superintendence.

(*B*) The Contractor shall not do any work or make any claim for payment for work contemplated by this contract, plans and estimate of quantities except such as is classified in the list of priced items herein contained and bid upon, the prices of which items include all labor, material and expense of constructing the work herein contemplated. If .... (the Owner) .... wishes other work done or the Contractor wishes payment for doing work not so classified or included, a separate contract shall be concluded between the parties to this end and no such extra work shall be done or money paid therefor unless such contract has been concluded, save that extra work done by authority of .... (the Owner) .... in writing may be performed under special agreement on the basis of cost plus fifteen (15) per cent provided the amount of extra expense involved under such agreement shall not exceed one thousand dollars ($1000); said cost to be proven by a Contractor's itemized bill of labor and material verified by him under oath and approved by the Engineer.

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* The following has been suggested (Conn. Soc. C.E., 1909, p. 6) as an iron-clad clause covering this point:

. . . " And before any monthly payments are made to the Contractor, he shall sign and deliver to the Party of the First Part the following declaration:

'I hereby declare that during the month of (the month just past), (year), I have not performed any work, furnished any materials, sustained any loss, delay or damage, or otherwise done anything for which I shall ask, demand, sue for or claim compensation from (Party of the First Part) in addition to the regular items of prices set forth in contract or contracts dated ( ), and executed between myself and (Party of the First Part) except as I hereby make claim for additional compensation as set forth on the itemized memorandum herewith attached.

(Signed)
(Dated) ' "

(Even were an experienced Contractor willing to subscribe to such a clause it seems doubtful whether its use would always prove effective.)

(*C*) The Contractor shall do such extra work and furnish such material as may be required by .... (the Owner) .... for the proper completion or construction of the whole work herein contemplated; he shall make no claim for extra work unless it shall have been done in obedience to a written order from the Engineer, approved by .... (the Owner) .... All bills for extra work done in any month shall be filed in writing with the Engineer before the fifteenth of the following month; and said Contractor, if he fail to file such claims within the time required, shall forfeit all rights to payment for such extra work. The Contractor shall receive for such extra work the actual cost of all materials furnished by him as shown by his paid vouchers approved by the Engineer. For such labor and teams as are necessary for such extra work he shall receive the current prices in the locality, which shall have been previously agreed to in writing by the

Engineer and by the Contractor, and approved by .... (the Owner) .... plus fifteen (15) per cent. No additional work will be considered as "extra work" which in the opinion of the Engineer can be properly included under the classifications of the contract.

(*D*) The Contractor shall be paid for extra labor done by him and for extra materials furnished by him in compliance with written order of the Engineer, calling for work not similar in character to that covered by the items given in the proposal, and for which no price is set in said written order, their direct (not including consequential) cost to the Contractor, as determined by the Engineer to be reasonable, plus fifteen (15) per cent of said cost as so determined in regard to labor and six (6) per cent in regard to materials. The direct cost of labor may include the cost of mechanics and laborers furnished and a reasonable proportion of the time of the foreman and timekeeper. It may also include the cost of insurance on pay rolls where the total amount on any one order exceeds five hundred dollars ($500), but it shall in no case include any charge for the use of tools, for establishment charges or for time spent by the Contractor. The labor and materials so ordered shall constitute a part of the work to be done under the contract; and all and singular the provisions of the contract shall apply to said labor and materials as if the same were specified therein. The Contractor shall have no claim for compensation for extra work and materials unless the same are ordered in writing by the Engineer. The Contractor shall make daily with the Engineer a minute and detailed comparison in regard to men, rates, materials, prices, etc., and the agreement or disagreement as to each shall be carefully noted. He shall in addition, within one week after doing any labor or furnishing any materials under an order given as aforesaid, deliver to the Engineer a copy of such order and an itemized bill, in duplicate, based thereon. The Contractor shall have no claim for the above named extra work or materials unless he furnishes the details and bills herein called for, and no other claim of the Contractor against .... (the Owner) ...... arising out of the execution of the contract shall be deemed valid unless said claim is presented to the Engineer within thirty (30) days from the time when he first knows of or has opportunity to know of the acts and circumstances on which the claim is based. A payment to the Contractor in cases where these provisions or any of them are not complied with shall not be construed as a waiver of such provisions or of any part thereof.

57. Frequency and Amount of Partial Payments.

(*a*) One of the more important duties of the Engineer during construction is that connected with the payment to the Contractor of the money he has earned. On a small contract one payment made after the work is completed will often be satisfactory, but common practice is to pay the Contractor an installment each month (except in case of "progress payments"*) as the work advances. This enables the Contractor to carry on the work with a smaller capital than he would require if he had to wait for his money until the work was finished. The size of the installment is determined by the Engineer, and is based on the amount of work the Contractor has done during the preceding month.

(*b*) It does not represent the full value of such work, however, as a small percentage, commonly either 10, 15 or 20 per cent is retained until after the work is finally accepted, principally as a safeguard against defects which the Engineer may have overlooked and against bills for materials or labor which the Contractor may have neglected to pay. Additional security is furnished by the bond. (See Art. 11.) If the percentage is made very large it discriminates against Contractors of limited capital. Accusations of favoritism in respect to certain banks have been made in instances where the percentage held back has been unnecessarily large. If made too small it will not prevent a dishonest Contractor from abandoning the work immediately after he has received a payment on account. The retained percentage may be said to represent in a general way the Contractor's profit.

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* How do these differ from monthly payments?

(*c*) The methods used by the Engineer in making up a partial payment account vary slightly, but are substantially as follows:

(*i*) With a unit price contract the process is comparatively simple, consisting merely in measuring the quantities of each class of work completed to date, and using these quantities, together with the unit prices in the contract, for computing the amount due the Contractor.

(*ii*) Under a lump sum contract the process is not quite so simple, as there are no unit prices on which to base the computation. In this event the Engineer must rely on his own judgment as to the value of the work done. (The Contractor might give him the computations on which he had based his bid, but of course he would be under no obligation to do so.)

The Engineer's Monthly Certificate (or Estimate), as it is called, is addressed sometimes to the Owner and sometimes to the Contractor. The phraseology would vary slightly according to circumstances, but the essential points to be covered are these:

(*i*) Recite the date of the contract and the full names and addresses of the principals thereto.

(*ii*) State the total value of the work done since the beginning of the contract.

(*iii*) From this total deduct the proper percentage as provided in the specifications.

(*iv*) Sum up the payments on account to date, and subtract the total amount from the above remainder leaving a balance due at a date which should be named.

(*v*) Sign, date and number the Certificate. Engineers' Certificates should be made out in triplicate (at least), one copy for the Contractor, one for the proper disbursing officer, and the third to be retained by the Engineer.

A troublesome question which sometimes arises in this connection relates to material which the Contractor has had delivered along the line of the work, but which is not yet in place. Shall the value of this material be included in any payments until the material is finally incorporated into the structure? Unless otherwise stipulated in the specifications at this point it would not be paid for until actually used, and it is doubtful if it is good practice to make any other arrangement in the specifications.* (See Art. 35.)

Typical Monthly Certificates

(I) (Assuming unit prices and addressed to the Contractor.)

Mr. J............ P............,
S............, N. Y.

Dear Sir:

I hereby certify that, in accordance with the terms of your contract with the Village of S............, dated ...., for building a sewer in X............ St. you have to date done work and furnished materials to the several amounts and values named below, viz:

2620 lin. ft. 10-in. pipe at 80 cents		$2096.00
1200 lin. ft. 8-in. pipe at 60 cents		720.00
10 manholes at $50 each		500.00
		$3316.00
Deduct 10 per cent		331.60
		$2984.40
Deduct payments as follows:		
No. 1	$ 800.00	
No. 2	1000.00	
No. 3	750.00	2550.00
Balance due		$ 434.40

You are therefore entitled to a payment of the above balance on account on or before the 10th inst., in accordance with the terms of said contract.

C............ C............,
Engineer in Charge.

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* Discuss this point by making comparisons between the case of brick or cement furnished for paving, dressed stone furnished for a wall, fabricated steel furnished for a bridge or building.

X............ St. Sewer, S............, N. Y.,
Engineer's Certificate No. 4,
Dated Mar. 3, 1912.

(II) (Assuming lump sum contract and addressed to the Owner.)

Mr. B. .... N............,
G............, Conn.

Dear Sir:

As provided in the contract entered into Jan. 3, 1912, between yourself and Mr. C............ M............ of G............, for building a concrete wall around your estate, I have this day measured the work completed by him to date and certify as follows, viz:

Value of work done to date	$6600.00
Deduct 15 per cent as per contract	990.00
	$5610.00
Deduct previous payments	5100.00
Balance due on or before June 10th	$ 510.00

Signed,

C............ C............,
Engineer.

Concrete wall for Mr. B............ N............,
Certificate No. 5, June 5, 1912.

Other methods of bookkeeping would bring the same result. In these illustrations the percentage is deducted before deducting the previous payments. A blunder would result if the sequence were reversed.

(*A*) At the end of each calendar month the Engineer will make an approximate measurement of all the work done and material delivered up to that date, classified according to the items mentioned in the contract, and will make an estimate of the value of the same on the basis of the unit prices named in the contract. To the estimates made as above set forth will be added the amounts earned for extra work to the date of the progress estimate. From the total thus computed a deduction of ten (10) per cent will be made and from the remainder there will be further deducted any amount due to .... (the Owner) .... from the Contractor as damages for delays or otherwise under the terms of the contract. From the balance thus determined will be deducted the amount of all previous payments and the remainder will be paid to the Contractor. The ten per cent deducted as above set forth will become due and payable to the Contractor upon completion of the work to the satisfaction of the Engineer.

(*B*) Payment for the work embraced in the contract shall be made in the following manner: — a payment will be made, on or about the first of each month, of ninety (90) per centum of the value of the work completed by the Contractor on the fifteenth of the previous month and not previously paid for, as estimated by the Engineer; allowance will not ordinarily be made the Contractor by the Engineer, in his estimates, for materials that are not in place, i.e. that are not in finished portions of the work which is in an unfinished condition; allowance may be made for all excavation done each month, and for materials delivered on the work when, in the opinion of the Engineer, such allowances are justified; provided, however, that the making of such payments may be deferred from month to month, when, in the opinion of the Engineer, the value of the work done since the last estimate for payment is less than three hundred dollars ($300); provided, further, that nothing herein contained shall be construed to affect the right, hereby reserved, of .... (the Owner) .... to reject the whole or any portion of the aforesaid work, should the certificate be found or known to be inconsistent with the terms of the contract or these specifications, or otherwise improperly given.

58. Conditions of Final Payment.

(*a*) When the work is finished and the Engineer, after a thorough inspection, is satisfied that it is complete and in accordance with plan and specifications in every detail, he issues his final certificate.

The following will serve to show how such a certificate might be worded. It may be addressed either to the Contractor or the Owner.

Typical Final Certificate

Mr. C............ M............,
G.............., Conn.

Dear Sir:

This is to certify that your contract dated .... for building a concrete wall around the estate of Mr. B............ N............ has been completed according to the plans and specifications therefor and to my satisfaction, and that you are entitled to payment as follows:

Total contract price [*]	$7500.00
Deduct 15 per cent as per contract [†]	1125.00
	$6375.00
Deduct previous payments	5610.00
Balance due on or before July 10th	$ 765.00

Signed,
C............ C............
Engineer.

Concrete Wall for Mr. B............ N............,
Engineer's Final Certificate, July 6, 1912.

(*b*) On the basis of this certificate a payment is made to the Contractor in an amount shown by the certificate, namely the balance due on the contract, less the percentage, which latter is still held for a period prescribed by the specifications, generally 30 days. This is to guard against liens,* and gives the Owner opportunity to inquire at the office where liens are recorded and assure himself that no liens are in force against the work or against any materials used therein. Some specifications require the Contractor to secure and furnish to the Owner a certificate stating that the official records show no outstanding liens affecting the case, making this a condition precedent to his receiving the payment of the retained percentage.

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[*] The extra work may or may not be mentioned in this certificate.

[†] The 15 per cent would be due at a later date, as August sixth. See Art. 57.

(*A*) The said Contractor shall not be entitled to demand or receive payment for any portion of the aforesaid work or material except in the manner set forth in the contract and these specifications until said work shall have been completed in accordance with the terms hereinbefore mentioned and the Engineer shall have given his certificate to that effect; whereupon .... (the Owner) .... will within seventy days after said completion and the delivery of said certificate pay or cause to be paid to the said Contractor in cash the whole amount of money then due the said Contractor under the contract excepting such sum or sums as may lawfully be retained under any of the provisions of the contract hereinbefore set forth.

(*B*) The Engineer shall, as soon as practicable after the completion of the work under this contract, make a final estimate of the amount of work done thereunder, and .... (the Owner) .... shall, within thirty days after such final estimate is so made, pay the entire sum so found to be due hereunder, after deducting therefrom all previous payments, and also all percentages and amounts to be kept and retained

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* Liens are claims against property for unpaid debts. Originally in common law, a lien gave a workman (a jeweller for example) the right to retain in his possession an article on which he had been working (as a watch) until he had been paid for his work. Common law has been supplemented within recent years in the United States by various State statutes, so that an unpaid workman may have a claim against the work even if it is physically impossible for it to be in his possession. Similar provision is made in favor of men who have furnished materials.

> under the provisions of this contract. All prior estimates and payments shall be subject to correction in the final estimate and payment. The Contractor shall furnish .... (the Owner) .... with satisfactory evidence that all persons who have done work or furnished materials and are entitled to a lien therefor under any statute or law of the State have been fully paid or are no longer entitled to such a lien before he shall demand any estimate or payments due or unpaid under this contract, and in case such evidence is not furnished an amount necessary to meet the lawful claims of the persons aforesaid may be retained from any moneys due or that may become due the said Contractor under this contract until the lawful claims aforesaid shall be fully discharged or satisfactorily secured, but it is understood and agreed that .... (the Owner) ...... assumes no obligations nor in any way undertakes to pay such lawful claims out of any funds due or that may become due the Contractor, or out of .... (the Owner's) .... own funds.

59. **Maintenance Clauses.** — When asphalt pavements were first introduced into the United States (about 1875), engineers knew little of the wearing qualities of the material. Hence originated the custom of requiring of the Contractor a guarantee that his work would last. This practice has since found wide use in connection with pavements of all kinds, and has been to a limited extent applied to other forms of construction.

(*a*) The security required of the Contractor is either:

(*i*) A percentage retained during the guarantee period, or

(*ii*) A security bond (smaller of course than the "faithful performance" bond). (See Art. 11.)

Of the two, the former is simpler and more direct, providing as it does a fund on which to draw in case the Contractor refuses to make the necessary repairs.

(*b*) The objections to requiring maintenance are three:

(*i*) The additional cost. The Contractor naturally adds the estimated expense of maintenance to his bid. Should the Owner assume the responsibility of maintenance he might be able to make his own repairs at a less expense.

(*ii*) The difficulty of accurately defining the term "maintenance." Shall the work appear as good as new at the end of the maintenance period? If not, how much wear shall be considered reasonable? Many foolish requirements, impossible of enforcement, have found their way into specifications in the attempt to set an arbitrary limit to the amount of ordinary wear.

(*iii*) The annoyance of forcing the Contractor to make the repairs. A dishonest Contractor has many excuses to offer in the effort to shirk this responsibility.

As applied to pavements, a most perplexing situation arises when portions of the pavement are necessarily disturbed by others (as for water or sewer connections). Another bone of contention is likely to appear where the amount of vehicular traffic suddenly increases during the period of guarantee, as in the case of a street which changes from a residence to a business street.

The period of maintenance of pavements has been steadily decreasing. Formerly ten years was a common requirement, now periods of from one to five years are the rule where any guarantee at all is required. Under most conditions better results can perhaps be attained at less expense without the maintenance clause — at least in the case of pavements.

(*A*) The Contractor agrees to make all the needed repairs on the said work during a period of one year after its final completion and he agrees that .... (the Owner) .... is authorized to retain out of the moneys payable to the Contractor under this agreement the sum of two (2) per cent of the amount of the contract and to expend the same or as much thereof as may be required in making the aforesaid repairs to the satisfaction of the Engineer if within ten days after the delivery or mailing of a notice in writing to the Contractor or his agents he or they shall neglect to make the aforesaid needed repairs; provided, however, that in case of an emergency where in the opinion of the Engineer delay would cause serious loss or damage .... (the Owner) .... may make repairs without previous notice and at the expense of the Contractor.

(*B*) The Contractor hereby further agrees that all the structures built by him under this contract shall be kept in good and satisfactory condition for the period of one year after the completion of the work to be done under this contract. Should any defects in the work or structures become evident before the expiration of the above guarantee the Contractor shall within five days from the date of the receiving of personal notice or the mailing of a notice by the Engineer to the Contractor proceed to remedy such defects of whatever nature or extent or whenever and wherever found in a proper manner and to the satisfaction of the Engineer and at the expense of the Contractor. In the event of the failure of the Contractor to begin such repairs within the five days above noted .... (the Owner) .... shall have the right to make such repairs and the cost thereof shall be paid by the Contractor; and it is expressly agreed by and between the Contractor and ...... (the Owner) .... that the surety bond attached to and made a part of this contract shall be in full force until the expiration of one year from the date of the payment of the final amount due the Contractor for work done and materials furnished under this contract.

UNIV. OF CALIFORNIA

CHAPTER XII

SPECIFIC CLAUSES

In the preparation of the specific or technical clauses, it is well to observe a few simple but important directions; in addition to those given in Chapter V, which the student should review at this point. For the distinction between specific and general clauses see Chapter II.

60. **Grouping.** — It is much easier to refer to these clauses as a whole if they be segregated from the general clauses and preceded by a proper heading.

61. **Sequence.** — As far as is practicable, they should be arranged, for convenience of reference, in chronological sequence (the order in which it is natural to expect the work to be done). This does not, of course, restrict the Contractor to the order observed in the specifications. In some specifications the clauses relating to materials are further segregated from those referring to workmanship.

62. **Indefinite Terms.** — Descriptive terms or units, unless perfectly definite, should be studiously qualified so as to make them definite.

(*a*) For the measurement of masonry, units such as cubic feet or cubic yards would appear to be, and in the case of many engineering structures are, perfectly definite. Certain well established trade rules, varying somewhat locally, affect the measurement of masonry in buildings. Such rules not infrequently provide for the double measurement of corners (or returns), and for the complete or partial disregard of openings (such as doors and windows).

Building stone is frequently required to be furnished by the cubic unit. In such cases it should be made clear as to whether the measurement is to be based on the volume of each separate stone, or of a heap of stone, or of the finished wall.*

(*b*) As applied to earth, the handling of some of which is necessitated in almost every engineering project, the term "cubic yard" needs qualification, for earth may be and is measured in one of three ways:

(*i*) Before it has been disturbed (*in situ*), as in railroad grading and similar work.†

(*ii*) In transit, as in a scow on dredging contracts, or in a cart.

(*iii*) In its final resting place, as in certain kinds of filling, for example the reclaiming of marsh land by the hydraulic process. In such cases the date of measurement and other points may need careful attention in the specifications, as some material continues to change volume for a long period of time.

(*c*) The lack of a proper differentiation of earth and rock in the specifications has occasioned a vast amount of unpleasant feeling and of litigation in connection with contract work of a certain character. Geologists make no real distinction between the two. In common parlance earth is soft and rock hard, but these adjectives lose much of their force where there is an almost imperceptible gradation between the two materials *in situ*. Three methods of classification follow:

(*i*) The distinction most commonly made is that anything requiring blasting for its removal will be estimated as rock. Not infrequently boulders of a certain minimum volume, and tree stumps, both of which it might be possible — though perhaps not economical — to remove in some other way, are classed as rock. In many instances "loose rock" is classified separately.*

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* Such units as "perch" should never be used by Engineers. A perch of masonry properly contains 24¾ cubic feet (16½ by 1½ by 1). In country districts where it is still in use as a unit a perch of masonry is variously assumed to contain anywhere from 22 to 25 cubic feet of stone.

Of interest in this connection is a publication of the Bureau of Standards, Department of Commerce and Labor, Washington, D. C., 1912, entitled "State and National Laws Concerning the Weights and Measures of the United States."

† The measurement of *rock* excavation is almost invariably made *in situ*.

> "No soft, loose or broken rock, impacted boulders or hardpan, but only such solid rock as may be approved by the Engineer in advance as requiring blasting for its removal, and boulders of one half (½) cubic yard or more found in and removed from the excavation, are to be considered as rock excavation."

(*ii*) Another plan for differentiation is based on the possibility of removing the material with a plow.

> "Dry excavation of rock will include the removal of all ledge rock and hardpan which, in the opinion of the resident Engineer, cannot be plowed, and all boulders measuring one-half a cubic yard or more." (N. Y. State Canals, 1904.)

(*iii*) A recent specification fixes the dividing line between earth and rock at three on the scale of mineral hardness (sometimes called the "Mohs" scale). The student should point out two difficulties apparently involved.

> "Whenever the word 'rock' occurs in these specifications, it shall be interpreted to mean any material geologically in place and of a hardness when first exposed of three or greater in the scale of mineral hardness, which corresponds to the hardness of the transparent variety of calcite. Other material will not be classed as rock, although it may be more economical to remove the same by blasting." (Chicago Sewers, 1911.)

The student should note that certain materials, such as hardpan or quicksand, while properly classed as earth, may in reality be more expensive to excavate than some grades of rock, and further, that it is sometimes advisable to classify earth or rock according to depth of excavation, length of haul, number of times it must be handled, amount of contained moisture, or in other respects. While it is practically impossible to draft a clause covering earth and rock which will be applicable to all local conditions geological and otherwise, painstaking definition in the specifications, and provision for special prices will lead to mutual understanding and often to lower bids. On large and important excavation contracts the expedient of using, as illustrations, samples obtained from borings may prove to be the only solution of the problem. The Contractor, in such case, bids on the classification as shown by the samples kept on file.*

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* Solid rock has been defined in some specifications as rock which rings when struck with a light hammer.

(*d*) Among other indefinite terms may be noted "a barrel of cement," "parts" (in expressions intending to give the proportions of a concrete or similar mixture), "ton," "ounce," "overhaul," "first (or second or third) class masonry," etc.

The student may discuss the uncertainty involved in each of the above terms. Reference to the construction news columns of engineering periodicals will enable the student to familiarize himself with the units in common use for the measurement of different sorts of work. He should prepare a list of the units employed in the measurement of the various parts of the work outlined in Chapter XIII.

63. **Stock Articles.** — Specify commercial sizes and patterns where practicable. Certain sizes of lumber are commonly carried in stock by dealers, while odd sizes must be especially ordered, unless they can be turned out from stock (which may mean a large percentage of waste). Rolling mills make a specialty of certain weights of rolled shapes, the patterns of pipe are becoming somewhat standardized, and in many other departments the Engineer will find that a knowledge on his part of the contents of trade catalogues may effect a saving for his clients.

64. **Special Brands.** — Where possible avoid requiring special brands or patented articles.†

(*a*) Otherwise those who furnish the particular article have a monopoly, and they might take advantage of the situation. Some patented articles are relatively expensive, at best.

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* It is a simple matter to use such a plan when the necessity arises for defining, for example, an unusual surface finish for concrete or stone masonry. The specifications might in such cases refer with equal propriety either to a prepared sample or to features of an already completed structure.

† This rule is not to be regarded as inflexible. Certain articles of standard price are of such excellence that they cannot be duplicated. The requiring of patented or monopolized articles on public work is wholly prohibited by some city charters and state laws; in others the qualification "except in case of absolute necessity" is added, while many contain no reference whatever to the matter. (See Art. 45.)

(*b*) A suspicion of favoritism or of collusion is difficult to live down.

(*c*) It is possible that other manufacturers may be able to furnish a better article. Word the specifications so as not to deprive the Contractor of some option in the matter.

65. Impossibilities. — Do not attempt the requiring of impossibilities.

It is essential that the Engineer appreciate the limitations of the material he expects to use. Not less necessary to him is an intimate appreciation of the average skill and habits of work of the men employed in the various building trades, for it is practically impossible to secure even from skilled mechanics a grade of workmanship much superior to that to which they have been long accustomed.

66. Grades of Quality. — It is perhaps unnecessary to remind the student of the futility of calling for or expecting to get "perfect" materials or workmanship of any description. It is not in all cases even necessary that these should be of the best quality (unless absolutely nothing else will serve). The Engineer should study his available materials and aim to make his specifications explicit respecting the grades of each he requires. Stone masonry, for example, costs anywhere from five dollars to fifty dollars or more a cubic yard, depending partly on the stone and the labor of quarrying and laying it, but much more on the amount of labor spent in dressing the surface to various finishes. Timber and lumber can generally be furnished in at least two grades, the best of which has certain well recognized imperfections. Second-hand steel rails or second-grade pipe will for some purposes be as serviceable as the newest and best — and so on through a long list. The classic definition of a Engineer describes him as a man who can do for a dollar what any ignoramus can do for two.

67. Results Versus Methods. — Specify results rather than methods. Aim to describe the finished structure with its constituent materials. There are two objections to specifying methods:

(*a*) It is possible that methods preferred by the Contractor may be more efficient.

(*b*) It will be impossible in such case to hold the Contractor to definite results.

Under some circumstances the Owner or the Engineer may be perfectly willing to accept results, in which case it is entirely reasonable to restrict the Contractor to a well-defined method.* Or it may be advisable to prescribe a method in detail, following the prescription with a statement that the Contractor will be allowed, by express permission of the Engineer, to substitute a method which he (the Contractor) is willing to guarantee will produce an equally good result. Cases of bridge erection have been dealt with thus.

Not many years ago all concrete was hand mixed; and specifications prescribed the process in great detail. Most types of machine mixers do the work at least as well, so that few specifications now define the method of mixing.

68. Balanced Treatment. — Important and essential features of the design should have the fullest and most explicit treatment. Matters involving much labor or expense need to be explained in greatest detail, whereas some points involving no additional expense can often be passed over with few words or even in silence.

The student may criticize and rewrite the following:

(*i*) (From specifications for masonry wall.) "The stone must be of limestone, sandstone or granite, of quality, size and shape acceptable to the Engineer."

(*ii*) (From specifications for a tunnel.) "Concrete lining shall be placed throughout the tunnel as indicated by the drawings. Any excavation beyond the neat lines of the tunnel section as shown on the drawings shall be filled to the satisfaction of the Engineer and no allowance will be made therefor."

(*iii*) (From specifications for concrete culvert.) "Concrete shall be composed of one part cement, two parts sand and four parts crushed stone."

(*iv*) (From specifications for a dam.) "In this excavation the kind of explosives used, the amount of the charges, the depth and direction of the holes, and the entire process of the work shall be under the direction of the

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* A case in point is the stipulation that structural steel shall be manufactured by the open-hearth process.

Engineer, the object being to do the work in such a manner as to avoid fissures in the remaining rock. If at any place the Contractor shall excavate, damage or shatter the bed rock beyond the lines given by the Engineer to be excavated, and it is necessary to replace the solid rock by masonry, then the Contractor shall supply such masonry free of cost to the Owner."

CHAPTER XIII

OUTLINES OF SPECIFIC CLAUSES

The following outlines are designed to furnish the student practical drill in the writing of the specific clauses of specifications for work of a comparatively simple nature. The student should consult the references in the Appendix, as well as any actual specifications which may be available, before proceeding with the composition. He should aim, however, toward a moderate degree of individuality of expression from the first, and his efforts in this direction should be subjected to the criticism of the Instructor, and possibly of the class.

Standard Specifications. For some years past there has been a movement toward standardizing the specific clauses of specifications for certain classes of work, or for certain materials. For example, each of the more important railway systems has prepared for its own use a set of "general" or "standard" specifications for masonry construction, a set for track laying, etc. Various individual engineers, or associations of engineers or of manufacturers have evolved "general" or "standard" specifications for steel construction, for pavements, for cement, for timber, etc. The student will find a number of these noted in the references in the Appendix. He would do well to secure some of them for his personal library.

69. Vitrified Pipe Sewer.

(*a*) *Preparing Trench.*

(*i*) In earth: — dimensions of trench; limit of length left open ahead; tunnelling; treatment of unstable subsoil.

(*ii*) In rock: — rock classification; section paid for; * excavated (   ) feet in advance.

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* In sewers and similar work involving rock excavation, the student should realize that it is unnecessary and practically impossible to excavate rock, unless it be soft, to a line. Hence arises the necessity in most instances of fixing in the specifications (sometimes on the plan) a limiting section, beyond which, if the Contractor excavates, he cannot expect compensation. In trench excavation this limiting section has been variously fixed as a rectangle, a trapezoid, or a combination of the two.

(*iii*) Miscellaneous contingencies: — intersecting drains, etc.; pumping; shoring or bracing; protection of existing structures (pipes, conduits, railway tracks, etc.).

(*b*) *Mortar and Concrete.*

(*i*) Requirements for cement (soundness, fineness, strength, etc.).

(*ii*) Quality of sand.

(*iii*) Size and quality of stone.

(*iv*) Proportions for mortar and concrete.

(*v*) Mixing; laying; protecting; binding.

(*c*) *Pipe.*

(*i*) Measurement of total length.

(*ii*) Quality and dimensions of pipe and specials.

(*iii*) Preparing bed.

(*iv*) Laying; jointing; cleaning, etc.

(*v*) House connections (or Y branches); size; frequency; capping; marking.

(*d*) *Accessories.*

(*i*) Manholes: — quality of material; method of erection; steps; head; cover.

(*ii*) Flush tanks.

(*e*) *Backfill.*

(*i*) Near pipe and elsewhere.

(*ii*) Tamping or puddling.

(*iii*) Replacing pavement (or covering pipe if laid on surface).

(*iv*) Limit left uncovered.

(*v*) Deficiency supplied.

(*vi*) Disposal of surplus.

(*vii*) Overhaul.

(*viii*) Cleaning up.

70. Macadam Road.

(*a*) *Grading.*

(*i*) Excavation: — classification and measurement; treatment of spongy material; disposal of surplus.

(*ii*) Embankment: — where obtained; deficiency; borrow pits; rock fill; earth fill.

(*iii*) Subgrade and shoulders: — forming, rolling and finishing each.

(*iv*) Grading of intersecting roads and drives.

(*v*) Overhaul.

(*b*) *Telford Foundation.*

(*i*) Location.

(*ii*) Quality and dimensions of stone.

(*iii*) Manner of laying and compacting.

(*c*) *Macadam.*

(*i*) Stone: — variety; tests; method of computing quantity.

(*ii*) First course: — size stone; thickness; rolling; binding and finishing.

(*iii*) Second course: — (same as above).

(*iv*) Third course: — (same as above).

(*v*) Specifications as to nature and use of binder (if bituminous or asphaltic).

(*d*) *Paved Gutters.*

(*i*) Extent; material; foundation; method of laying and finishing.

(*e*) *Side Ditches.*

(*i*) Location; size; payment.

(*f*) *Drains;* culverts; basins.

(*g*) *Guard Railing.*

(*i*) Extent; material for posts and rails; details of construction; painting.

(*h*) *Miscellaneous.*

(*i*) Retaining walls.

(*ii*) Riprap.

(*iii*) Sign posts.

(*iv*) Stone bounds or monuments.

(*v*) Milestones.

71. Laying Cast-iron Water Pipe and Accessories.

(*a*) *Preparing Trench.*

Section in rock and in earth; extra depth excavation; blasting; tunnelling; length open; shoring, etc.; drainage; care of existing structures.

(*b*) *Laying Pipe.*

Unstable subsoil; blocking; jointing; plugging; cutting; setting valves and hydrants; marking location of specials; tests under pressure.

(*c*) *Materials.*

(*i*) Pipe and specials: — reference to standard specifications; inspection.

(*ii*) Valves: — type; material and details; valve boxes; valve chambers.

(*iii*) Hydrants: — type, material and details.

(*iv*) Miscellaneous: — lead; yarn; mortar; concrete; brick; lumber.

(*d*) *Backfill.*

Character of material; consolidation; shortage and surplus; overhaul; cleaning up; repaving.

72. Small Reinforced Concrete Highway Bridge.

(*a*) *Excavation;* sheeting; preparation of foundation; provision for flow of stream; diversion of public travel; care of pipes, conduits, etc.

(*b*) *Cement:* — tests; delivery and storage; sampling.

(*c*) *Sand:* — quality.

(*d*) *Crushed stone* or gravel: — size, quality.

(*e*) *Steel reinforcement:* — quality of steel; cleaning.

(*f*) *Proportions,* mixing and laying concrete; use of spalls.

(*g*) *Forms:* — material.

(*h*) *Placing of reinforcement;* contact with concrete.

(*i*) *Bonding* of contiguous work.

(*j*) *Surface finishing;* protection.

(*k*) *Restoring highway:* — repaving; surplus material; cleaning up; disposal of old bridge.

73. Concrete Sidewalks and Curbing.

(*a*) Excavation; foundation; drainage; roots of trees.

(*b*) Forms.

(*c*) Quality and proportions of cement, sand and stone for each course and for curbing; coloring; reinforcement (or corner bar) for curb.

(*d*) Mixing and laying concrete; finishing surface; expansion joints; protection from elements.

(*e*) Disposal of surplus material; grading and cleaning up.

74. Retaining Wall of Ashlar Masonry.

(*a*) *Excavation;* drainage; foundation.

(*b*) *Dressed stone:* — quality; dressing of each bed; thickness of courses; limiting dimensions of headers and stretchers; treatment of edges.

(*c*) *Backing stone:* — quality; dimensions; laying.

(*d*) *Mortar:* — cement; sand; mixing, etc.

(*e*) *Construction of wall:* — proportion of headers to stretchers; bedding; bonding; thickness of joints; breaking joints; use of mortar; use of spalls; disturbance of bedded stone; construction of backing; weep-holes; pointing up.

(*f*) *Coping:* — size; dressing.

(*g*) *Finishing:* — removal of surplus material; cleaning up.

75. Small Earth Dam.

(*a*) *Clearing and stripping site:* — excavation; drainage trenches; springs; care of stream; etc.

(*b*) *Puddle core:* * — material to compose; laying and compacting.

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* The student may substitute a concrete core-wall, for which he should prepare his own outline.

(*c*) *Main portion of dam:* — choice of material for upstream portion; for downstream portion; riprap slopes; sodding or seeding.

(*d*) *Cement:* — sand; mortar; brickwork.

(*e*) *Gatehouse;* gates; waste-weir, etc.

76. Pile and Timber Dock (or Trestle).

(*a*) *Piles:* — variety and quality of wood; (creosoting); straightness and limiting dimensions; preparation of points and of butts for driving; driving; penetration; load formula; sawing off; payment for.

(*b*) *Timber:* — variety, quality and dressing of wood for different portions; allowable defects (such as seams, knots, knot-holes, sapwood, splits, wind-shakes); framing; flooring.

(*c*) *Bolts and nuts;* washers; spikes.

(*d*) *Painting;* cleaning up.

77. Wood Block Pavement.

(A large portion of this outline would, of course, apply equally well to brick, stone-block or other "permanent" pavements).

(*a*) *Excavation:* — disposal of surplus material; overhaul; rolling subgrade.

(*b*) *Curbing:** — material; dressing; setting; headers, — material and setting.

(*c*) *Catch basins:* materials and workmanship; storm drains.

(*d*) *Concrete foundation:* — cement; sand; stone; mixing; laying; protection.

(*e*) *Cushion coat:* — materials and preparation.

(*f*) *Wood blocks:* — wood; dimensions; oil; treatment; testing; laying; grouting; expansion joints; covering; protection.

(*g*) *Removal of rubbish,* etc.

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* For concrete curbing see Art. 73.

APPENDIX

REFERENCES

The following list of references is submitted with no claim for its completeness. In its preparation the author had in view the accessibility of the various publications to the average student in Civil Engineering. Occasional valuable articles on specifications (abstracts of many of which will be found among the magazine references) have appeared in publications of the American Society of Civil Engineers, of numerous local engineering societies, of the Society of Municipal Contractors, of the American Society of Engineering Contractors, of the American Society of Municipal Improvements, of the American Society for Testing Materials, of the American Public Works Association and others.

CONTRACT VERSUS DAY'S WORK

Engineering News:

1906, v. 56, p. 411 (cost plus a fixed sum).
1910, v. 63, p. 415 (cost plus a fixed sum); pp. 101, 503, 504 (relative efficiency).
1911, v. 66, pp. 115, 117 (day's work at New Orleans).
1912, v. 68, p. 34 (day's work at Minneapolis).
1912, v. 68, p. 392 ("contract payments based on cost").

Engineering Record:

1909, v. 59, p. 530 (cost plus a fixed sum).

CONTRACTS, CONTRACTORS, ETC.

Under this heading are included references to broad discussions of the mutual relations of Contractor, Engineer and Owner.

Engineering News:

1902, v. 48, p. 45 (contract enforcement); p. 213 (engineers, contractors and specifications); p. 237 (price of risks); p. 287 (duty of engineer to contractor).
1903, v. 49, p. 146 (young engineers and contractors).
1905, v. 53, p. 594 (specifications, contracts and lawsuits).
1907, v. 57, pp. 587, 595 (public contracts); p. 649 (U. S. Reclamation Service specifications, notes).
1907, v. 58, pp. 356, 363 (a contractor's point of view).
1908, v. 60, p. 368 (loose specifications and dishonest contractors).
1912, v. 67, p. 439 (bonds and sureties).

Engineering Record:
1906, v. 53, p. 100 (preserving contractor's rights).
1910, v. 62, p. 18 (standardizing forms).
1911, v. 64, p. 604 (comment on N. Y. City specifications and contracts); pp. 644, 678, 777 (relations of engineers and contractors).
1912, v. 66, p. 527 (alternative methods).
1912, v. 66, p. 589 (objectionable features, government contracts).
1912, v. 66, p. 693 (unfair clauses).
1913, v. 67, p. 148 (public work contracts).

Engineering-Contracting, Nov. 17, 1909 (symposium).

Connecticut Society of Civil Engineers, 1909 Report, p. 1 (engineer in court).

Ohio Engineering Society, 1907 Report, p. 80 (contracts and contractors).
1908 Report, p. 60 (specifications and their improvement).

Society of the Municipal Engineers of New York City, May, 1904 (general discussion).

ADVERTISEMENT AND INFORMATION FOR BIDDERS

Engineering News:
1905, v. 54, p. 466 (fraudulent advertising).
1907, v. 57, p. 587 (obscure advertising).
1909, v. 61, p. 631 (local bidders).
1911, v. 66, p. 306 (theory of advertisement); p. 321 (public corporation advertising).
1912, v. 67, p. 434 (summary, instructions to bidders, etc.).

Engineering Record:
1903, v. 48, p. 1 (competition in local work).
1905, v. 52, p. 676 (U. S. government work).
1908, v. 57, p. 220 (approximate estimates).
1908, v. 58, p. 29 (rejecting all bids).
1910, v. 61, p. 289 (approximate estimates).

Ohio Engineering Society, 1908 Report, p. 144 (approximate estimates).

PROPOSAL

Engineering News:
1903, v. 50, p. 269 (laws governing awards).
1904, v. 52, p. 181 (security with bids); p. 363 (precautions in preparing blanks); p. 423 (mentioning time).
1905, v. 54, pp. 466, 515 (fraudulent proposals).
1907, v. 57, p. 588 (fraudulent proposals).
1908, v. 60, p. 439 (lowest responsible bidder).
1909, v. 61, p. 175 (pooling bids, Germany).
1909, v. 62, p. 100 (lowest bidder, Ohio).
1912, v. 67, p. 434 (instructions to bidders).
1912, v. 68, p. 173 (pooling bids).

Engineering Record:
1906, v. 54, p. 37 (lowest bidder, Cross River dam).
1907, v. 56, p. 220 (lowest bidder, Ashokan dams).
1911, v. 64, pp. 61, 231 (lowest bidder).

Lump Sum versus Unit Prices

Engineering News:
1905, v. 53, p. 17 (advantages of unit prices); p. 100 (advantages of lump sum).
1907, v. 57, p. 588 (unbalanced bids).
1912, v. 67, p. 743 (unbalanced bid tricks).

Engineering Record:
1909, v. 60, pp. 572, 645 (percentage unit plan).

COMPOSITION OF SPECIFICATIONS

Engineering News:
1909, v. 61, p. 386 (a Nova Scotia lawsuit).
1912, v. 67, p. 443 (the writing of specifications).

GENERAL CLAUSES

Specifications and Plans

Engineering News:
1903, v. 50, p. 543 (omissions).
1905, v. 53, p. 594 (sufficiency of plans).
1905, v. 54, pp. 577, 580 (alterations, Manhattan bridge).
1906, v. 55, pp. 120, 128 (alterations, Manhattan bridge).

Engineering Record:
1905, v. 52, p. 713 (guarantee of correctness).
1908, v. 57, p. 114 (change in sewer plans).
1911, v. 64, p. 724 (alterations in specifications).
1912, v. 65, p. 366 (sufficiency of plans, England).
1912, v. 65, p. 477 (copying specifications).
1912, v. 66, p. 449 (sufficiency of plans).

The Engineer during Construction

Engineering News:
1902, v. 48, p. 213 (limits to engineer's authority).
1903, v. 50, p. 543 (powers of engineer).
1905, v. 53, pp. 76, 344, 594 (powers and duties of engineer).
1907, v. 58, p. 2 (enforcement of specifications).
1909, v. 61, p. 387 (death of engineer).
1912, v. 67, p. 166 (engineer's liability to contractor).
1912, v. 68, p. 682 (arbitration board).

Engineering Record:
1905, v. 52, p. 748 (acceptance of material, etc.).
1910, v. 61, p. 318 (verbal orders).
1911, v. 64, p. 331 (arbitration).
1911, v. 65, p. 348 (discretion of engineer).
1912, v. 66, p. 72 (arbitration).
1912, v. 66, p. 100 (engineer's decision and board of arbitration, England).

Western Society of Civil Engineers, 1912 Report (arbitration).

Transactions American Society of Civil Engineers: v. 58, pp. 345, 380 (powers of engineer).

The Contractor's Miscellaneous Responsibilities

Engineering News:
1912, v. 68, p. 455 (German decision on accidents).

Engineering Record:
1908, v. 58, p. 627 (accidents to workmen, faulty material).
1911, v. 64, p. 495 (liability insurance).
1912, v. 65, p. 190 (responsibility for accidents).

Progress of Work

Engineering News:
1903, v. 49, p. 216 (damages for delay).
1904, v. 51, p. 284 (penalty clause).
1905, v. 53, p. 258 (delay and suspension, railroad work); p. 594 (time limit, etc.).
1905, v. 54, p. 356 (damages for delay, Williamsburg bridge).
1906, v. 55, p. 88 (strike clause, building contracts); p. 323 (damages for delay).
1911, v. 65, pp. 602, 603 (court decision, time penalty).

Engineering Record:
1906, v. 53, p. 48 (delays, suspension); p. 120 (penalties and forfeitures).
1908, v. 57, pp. 387, 587 (delay).
1908, v. 58, p. 383 (time penalty clauses).
1909, v. 60, p. 152 (penalty vs. liquidated damages).
1910, v. 61, p. 765 (delay).
1911, v. 64, p. 246 (delay); pp. 347, 351 (reasonable diligence).
1912, v. 66, p. 561 (delays), p. 657 (liquidated damages decisions).

Engineering Magazine, Feb., 1904.

U. S. Statutes, 183d., Sun Printing Co. vs. Moore (penalty and liquidated damages), Oct., 1901.

Terms of Payment

Engineering News:
1903, v. 49, pp. 216, 369 (subletting).
1903, v. 50, p. 78 (per cent profit).

1904, v. 52, p. 151 (assignment); pp. 198, 242 (per cent retained).
1905, v. 53, p. 339 (unpaid bills, U. S. government contracts).
1905, v. 54, p. 42 (extra work clauses); pp. 577, 581 (illegal extra work).
1906, v. 55, pp. 120, 128 (illegal extra work).
1907, v. 58, p. 356 (extra work).
1909, v. 61, p. 196 (extra work clauses).
1910, v. 63, p. 266 (maintenance).
1910, v. 64, p. 491 (maintenance).
1912, v. 68, p. 284 (subcontractor clause); p. 529 (maintenance); p. 1043 (extra work 530 B.C.).

Engineering Record:
1906, v. 53, p. 22 (extra work); p. 66 (receipt in full).
1907, v. 55, p. 667 (final certificate).
1910, v. 62, p. 478 (extra work).
1912, v. 66, p. 142 (guarantee of performance).
1913, v. 67, pp. 48, 352 (extra work).

Municipal Engineering: 1913, v. 44, p. 118 (extra work).

Connecticut Society of Civil Engineers, 1909 Report, p. 6 (extra work clauses).

SPECIFIC CLAUSES

The American Society for Testing Materials has issued standard specifications for ferrous metals, non-ferrous metals, cement and clay products, and miscellaneous materials (including road material, bitumen, lumber, etc.). The American Railway Engineering Association has prepared standard specifications for a variety of materials, including steel and iron, timber, etc. Ostrup's "Standard Specifications for Structural Steel, Timber, Concrete and Reinforced Concrete" is a useful reference book. The National Association of Cement Users issues pamphlets containing specifications for sidewalks, building blocks, street pavements, curb and gutter, various concrete surfaces, etc.

References to other standard specifications and to discussions of points in connection with specific clauses follow.

Sewers

Ogden, "Sewer Construction."

Engineering News:
1903, v. 50, p. 342 (measurement of length).
1905, v. 53, p. 367 (measurement of length).
1913, v. 69, p. 484 (sewer pipe).

Engineering Record:
1908, v. 57, p. 114 (change in sewer plans).
1910, v. 61, pp. 3, 25 (N. Y. City).
1913, v. 67, p. 235 (vitrified pipe).

Municipal Engineering:
  1910, v. 39, p. 317 (St. Louis).
  1912, v. 42, p. 90 (outline).

Engineering World, Oct. 5, 1906.

Macadam Roads

The standard specifications of various states, as Massachusetts, New Jersey, New York, Connecticut, Maryland, California. (These are sometimes included in the annual reports of the highway commissions, and are printed separately.)

Organization for Standardizing Paving Specifications.

Engineering News:
  1904, v. 52, p. 241 (defective specifications).
  1912, v. 68, pp. 1018, 1106 (patent infringements, road contracts).

Municipal Engineering, 1909, v. 37, p. 254 (bituminous macadam).

Engineering-Contracting, Dec. 8, 1909 (bituminous macadam).

Cast-Iron Water Pipe (and accessories)

American Water Works Association.

New England Water Works Association. (Either of these standard specifications may be found in pipe manufacturers' handbooks.)

Engineering News, 1904, v. 52, p. 287 (comments).

Concrete and Stone Masonry

Baker, "Masonry Construction."

Watson, "General Specifications for Concrete Bridges."

Pamphlets issued by cement manufacturers.

Engineering News:
  1905, v. 53, pp. 41, 98 (value of perch).
  1910, v. 64, pp. 492, 540 (Chicago concrete measurement rules).
  1912, v. 67, p. 775 (stone masonry, Kensico Dam).
  1913, v. 69, p. 121 (concrete dam).

Municipal Engineering:
  1909, v. 36, p. 227 (concrete bridges).
      v. 37, pp. 178, 186 (concrete walks).
  1910, v. 39, p. 385 (expansion joints, walks).

Lumber or Timber

U. S. Forestry Bulletin No. 71.

Various Lumbermen's Associations Standards, as that of Yellow Pine Manufacturers Association, etc.

Pavements

Organization for Standardizing Paving Specifications.

Whinery, "Specifications for Street Roadway Pavements."

Manufacturers of paving material, as National Paving Brick Manufacturers Association, Wood Preservers Association, etc.

Engineering News:
1910, v. 63, p. 266 (maintenance guarantee).
v. 64, p. 491 (contractor's view of maintenance).
1912, v. 67, p. 654 (maintenance guarantee).

Engineering Record, 1908, v. 58, p. 31 (asphalt).

Municipal Engineering:
1909, v. 36, p. 238 (wood block, Indianapolis).
v. 37, p. 42 (maintenance guarantee).
1911, v. 40, pp. 223, 523 (wood block).
1913, v. 44, p. 116 (asphalt).

Engineering-Contracting:
Nov. 10, 1909 (pavement foundations).
June 15, 1910 (wood block, summary of requirements).

Grading, etc.

Engineering News:
1904, v. 51, p. 178 (plowing test, excavation).
v. 52, p. 288 (protecting embankment slopes); p. 424 (plowing test, excavation).

Engineering Record:
1909, v. 59, p. 366 (plowing test, excavation).
1911, v. 64, p. 604 (payments for rock excavation).

Steel and Iron

Osborn's, Cooper's, Waddell's, American Bridge Company's specifications, etc.

Railroad Age Gazette, May 21, 1909 (five specifications compared).

Collection and Disposal of City Wastes

Engineering News, 1910, v. 53, p. 175 (Boston).

Materials in General

Municipal Engineering, 1909, v. 36, p. 234 (quality).

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